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THE INDEPENDENT GUIDE TO PERSONAL COMPUTING VOL. 17 NO. 11 JUNE 9, 1998

2001



Computing in the New Millennium

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The Way the Future Wasn't



Two thousand one. 2001. The year conjures up old images of a future in which space flight is commonplace, we have colonies on the moon, and computers are huge behemoths that talk to us and understand what we say. But that's not the way 2001 will turn out. Manned space flight is a rarity, and no human has landed

mile-high skyscrapers, many of us grew up with science-fiction ideas about the future.

No one predicted the future exactly, of course, and in no area were the predictions farther from the mark than in computers. We read a lot about robotics and intelligent computers, but we read very little about PCs or the Internet until they were already with us. It's easy today to look at

on the moon in decades. And—for better or worse—the computers we use won't be anything like the HAL 9000 that Arthur C. Clarke and Stanley Kubrick imagined. Then again, predicting the future has always been an uncertain activity.

Think about the science-fiction future scenarios of the fifties, with people flying from here to there in personal aircraft or with rockets on their backs. Think about how Disneyland's Tomorrowland now seems quaint. Think about the visions of the future shown at various world's fairs, the random predictions of the future that various magazines have given, and even predictions given at trade shows from today's movers and shakers.

Invariably, they're wrong. And invariably, in this special issue, some of our predictions about the future will also be incorrect.

Predicting the future has become a cottage industry lately, with so-called experts making good livings predicting what will happen in business, technology, and society. But this isn't a new phenomenon; it's been part of human cultures for centuries.

I remember a Smithsonian Institution exhibition titled "Yesterday's Tomorrows" that appeared back in 1984. (Remember 1984? George Orwell made a lot of predictions for that year, guessing correctly on some and wildly missing on others. We still don't really know whether computers will lead to more or less government control, but keep your eyes on those privacy and encryption debates.) This exhibition illustrated the way people throughout the early part of the 20th century envisioned the future, and it also highlighted the changes in how Americans viewed the way things would be. With visions of robotics, space flight, and

these old books, films, and magazines and laugh, but they were the visions that many of the creators of today's technology took to heart.

So when we sat down to plan this issue and predict what computing will be like in 2001, we knew the challenges involved. We're pretty confident about the basic directions of technology over the next three years; 2001 isn't that far away, after all. But the details are always hazy. And as we look even farther into the future, as in our gatefold on life in 2010, the best we can do is make some educated guesses.

So why try to predict the future at all? In part, we do this because people are always interested in what will happen, even if we know it won't all come true. And in part, we do this because imagination points the way to new developments.

If it weren't for science fiction, I'm sure there would be far fewer people today involved in designing and building the computers we use. Were it not for the visions of what the future could be like—both the good and the bad—we would have a very different present, because the dreams that we have help shape our reality.

Much of what is better about life today compared with the way it was years ago, whether you're talking technology, arts, medicine, or society in general, is the result of people who dreamed about the future. As Alan Kay, a Disney Fellow, is fond of saying, the best way to predict the future is to create it.


MICHAEL J. MILLER

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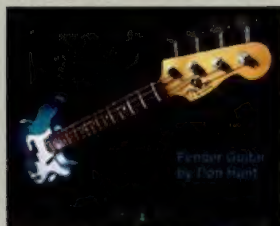


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COVER STORY

2001 Computing New Millennium

Excited about the future? You should be.

We can't say how crazed the stock market will be in two or three years, but we've got a pretty good idea about what personal computing will look like—and in keeping with the times, we're tellin' all! Looking just a few years ahead, our editors and Labs staff give you a realistic idea of which cutting-edge technologies will take hold and become the basis for widely popular products. We've also visited the research and development labs of several leading vendors to give you a look that's farther out101



SPECIAL FOLDOUT

2010: A Day in the Life In the New Millennium

What awaits users of personal computers well into the next century? You want to know as much as we do. *PC Magazine's* senior executive editor Bill Howard takes you on a tour of your computing life in the year 2010. Is it all far-fetched? Just remember [how far we've come over the last 15 years](#).....203

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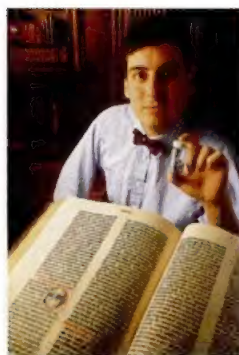
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FLASH FORWARD

Coming Soon from a Research Lab to You

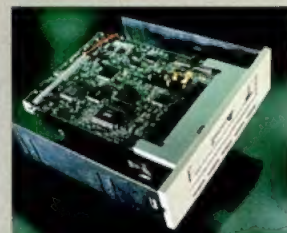
Wearable PCs. Electronic ink. Dial any phone just by touching it. And the cars! Cars that accept voice commands and give directions. Cars with multimedia centers in back for the kids. Are we there yet?

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Pipeline

Secrets and Source Code

What's driving Web developers to make their once tightly guarded software recipes available to the public, including the competition? In an effort to seed the market for a harvest of software, developers are publishing their specifications in the hope that their creations will become industry standards.

In January, Netscape surprised the industry by making the source

other Web development tools—including Apache, Linux, and Perl—whose source codes have always been free.

More recently, Macromedia published the specification for Flash, a Web animation and graphics tool, to let developers support it in their tools. (The company plans to license the source code so developers can embed the player in programs, eliminat-



code (the software engine) for its next Internet applications suite, Netscape Communicator 5.0, available for free download. Developers can enhance the code and use it for new applications without paying licensing fees.

Netscape's thinking goes like this: With thousands of developers working to improve the company's browser, more people will use it. This rising tide will drive customers to Netscape's money-making businesses: enterprise software and Web site services. Netscape is following in the footsteps of the creators of some

ing the need for a plug-in.) The long-term goal is to establish the Flash file format (SWF) as a standard for vector graphics used on the Web, in much the same way that GIF and JPEG files are standards for bitmapped images.

Meanwhile, Adobe recently submitted the specification for its Precision Graphics Markup Language (PGML) as a standard for vector graphics complementing Macromedia's technology. PGML uses XML, a nascent Internet language that many believe will usher in a new generation of Web applications.

Desktop "Holograms"

What happens to your 3-D design when you try to print it? 3D COM (www.3dhardcopy.com) has come up with an innovative process that creates the illusion that printed images have a third dimension. Special software creates a composite image from 36 perspectives, each with the image rotated one-sixteenth of an inch. The printed image appears as a blur. But when you place over it a clear piece of plastic with vertical ridges (a lenticular lens), the blur turns into a hologram-like image. 3D COM offers a Web-based service; e-mail your 36 images and receive a HardCopy in the mail (\$40 for a single copy, \$20 for each additional one). In a few months, the company expects to sell the software and lenses so customers can make HardCopies at their desktops.

PC Price Poll

of our readers
spent \$2,000 to \$3,000
on their most recent PCs.
Another 31 percent spent over \$3,000.
Only 6 percent told us they spent
less than \$1,000.

Tag, You're Out

Secret passwords, fingerprint ID peripherals, and chip-based smart cards may prevent snoopers from stealing the data on your computer, but what's to prevent a thief from snatching your notebook? Researchers at IBM have come up with a technology called Asset ID, which could turn out to be one way to stop notebook computers from walking out the door.

In the second half of the year, IBM expects to offer radio-frequency ID tags—each consisting of some software code built into EEPROM, along with an embedded antenna—on certain ThinkPad models. Once activated by a sensor that's

installed, say, at the entrance to an office building, a tag will cough up each machine's serial number, the name of the person to whom it's registered, and its security classification. When used with a security system, the tag can match the information against an employee's ID badge to help prevent unauthorized removal of a notebook.

MIS managers can also use it to take inventories without opening machines or crawling under desks in search of labels. They can track configurations, serial numbers, and other vital statistics by just pointing a portable wand at the equipment, whether it's on a desk or packed in boxes.



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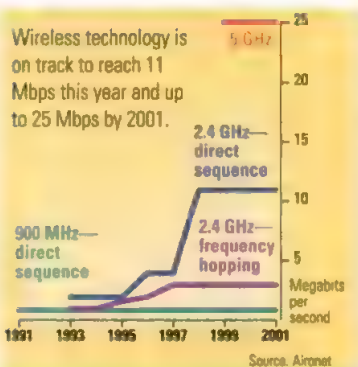
Wireless Is Ready for Takeoff

Every year, advances in wireless networking coax data to travel faster and farther, but the market hasn't expanded much beyond specialized applications for factories, hospitals, and stores. This year could be different as manufacturers start to roll out interoperable hardware based on an international wireless-networking standard that was set last June.

Ohio-based Aironet Wireless Communications, for instance, has received FCC approval for an 11-Mbps wireless PC Card; such cards were capable of only 2 Mbps a year ago. The card would let you roam within a building or campus while staying connected to network resources, including data, voice, and video. Aironet is working now on a supersmall, low-power wireless technology for connecting the 3Com Pilot to the corporate network.

Later this year, the growing army of business travelers will be able to tap into the Web and cor-

porate networks from airport waiting areas and hotels without tethering themselves to phone lines. MobileStar Network, based in Richardson, Texas, has an agreement with American Air-



lines to install wireless network-access equipment in the country's top 49 airports. Sheraton Hotels also plans to offer the service. Subscribers will have radio-frequency cards that will connect their notebooks at high speeds to network access points, which will connect over wires to the Internet and corporate networks.

Next Year's Workhorse PC

What will the basic PC of 1999 be like? If Bill Gates's keynote address at the recent Windows Hardware Engineering Conference (WinHEC) was a barometer, it will have significantly faster processor and memory bus speeds, at least a 300-MHz Pentium II chip, 32MB of RAM, and a price tag well over \$1,000.

The Microsoft/Intel PC 99 specification also calls for a memory bus speed of 100 MHz. And Microsoft would like to see USB and 1394 ports replacing serial and parallel ports. The Entertainment PC specification calls for a 2X DVD-ROM drive.



WinHEC included many demonstrations of upcoming bandwidth-hungry applications, which will require the breaking of bus bottlenecks, new graphics-handling technologies such as

Advanced Graphics Port (AGP), and new high-bandwidth pipes to the Internet. Gates is extremely high on 3-D technology on the Web, and he

also sees low-cost DSL becoming very popular. DSL, he believes, should boost online applications such as photography, music downloads, and video editing.

Digital Econ 101

When President Clinton took office, there were only 50 Web sites. Now 65,000 are being added—every hour,” said Secretary of Commerce William M. Daley at a recent meeting of the Information Technology Policy Council. “Last year 100 million people logged on to the Internet, up from 40 million the year before,” he added.

The point illustrates how the digital economy has grown up, and it underscores the importance of addressing the threats to further growth in the information-technology industry, which makes up more than 8 percent of our economy. Daley's report, “The Emerging Digital Economy,” identifies the dearth of



skilled workers as a major obstacle. “We will require 1.3 million new information-technology workers over ten years. That is more people than build cars and trucks at the Big Three,” he said.

Online privacy also tops Daley's list of concerns. “To me, this is the make-or-break issue.”

Top-Selling Desktop Utilities

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Norton AntiVirus Symantec
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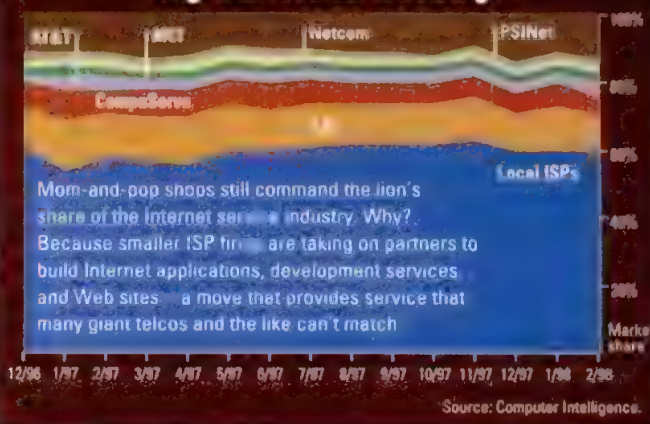
Source: Computer Intelligence InfoBeads. Data for February.

CD-RW Makes a Comeback

Rewritable-CD technology (CD-RW) doesn't grab headlines as it once did, thanks to the buzz surrounding DVD. But it may be poised for a boost. Drives have fallen from \$1,000 a year ago to under \$500 and are expected to reach \$200 this year. Research firm IDC says CD-RW will hold 19 percent of the recordable-media market by 2001.

It's likely to be a temporary blip, though. IDC also sees 2000 as the last year when CD drive sales will outpace sales of DVD drives.

My ISP Acts Locally



THIS ISSUE'S CONTRIBUTORS: Angela Hickman, Carol Levin, Sebastian Rupley, and Don Willmott.

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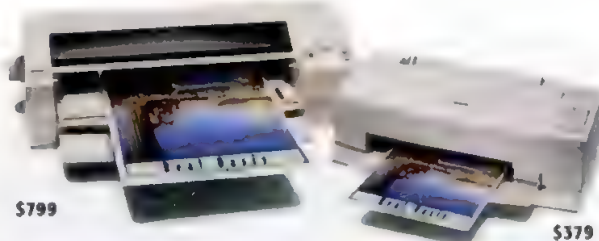
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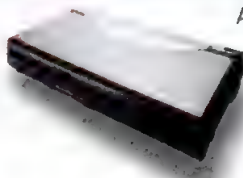
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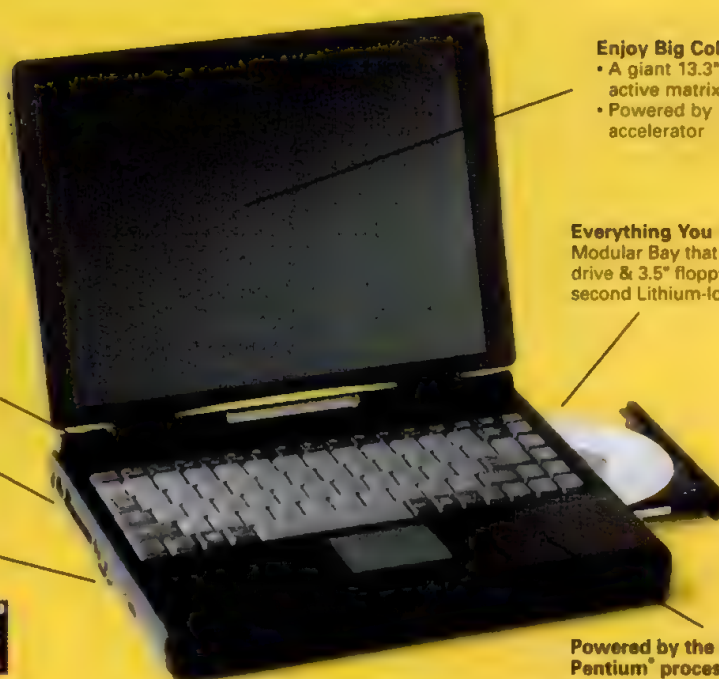
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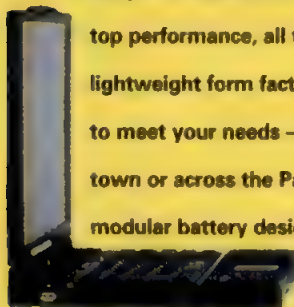
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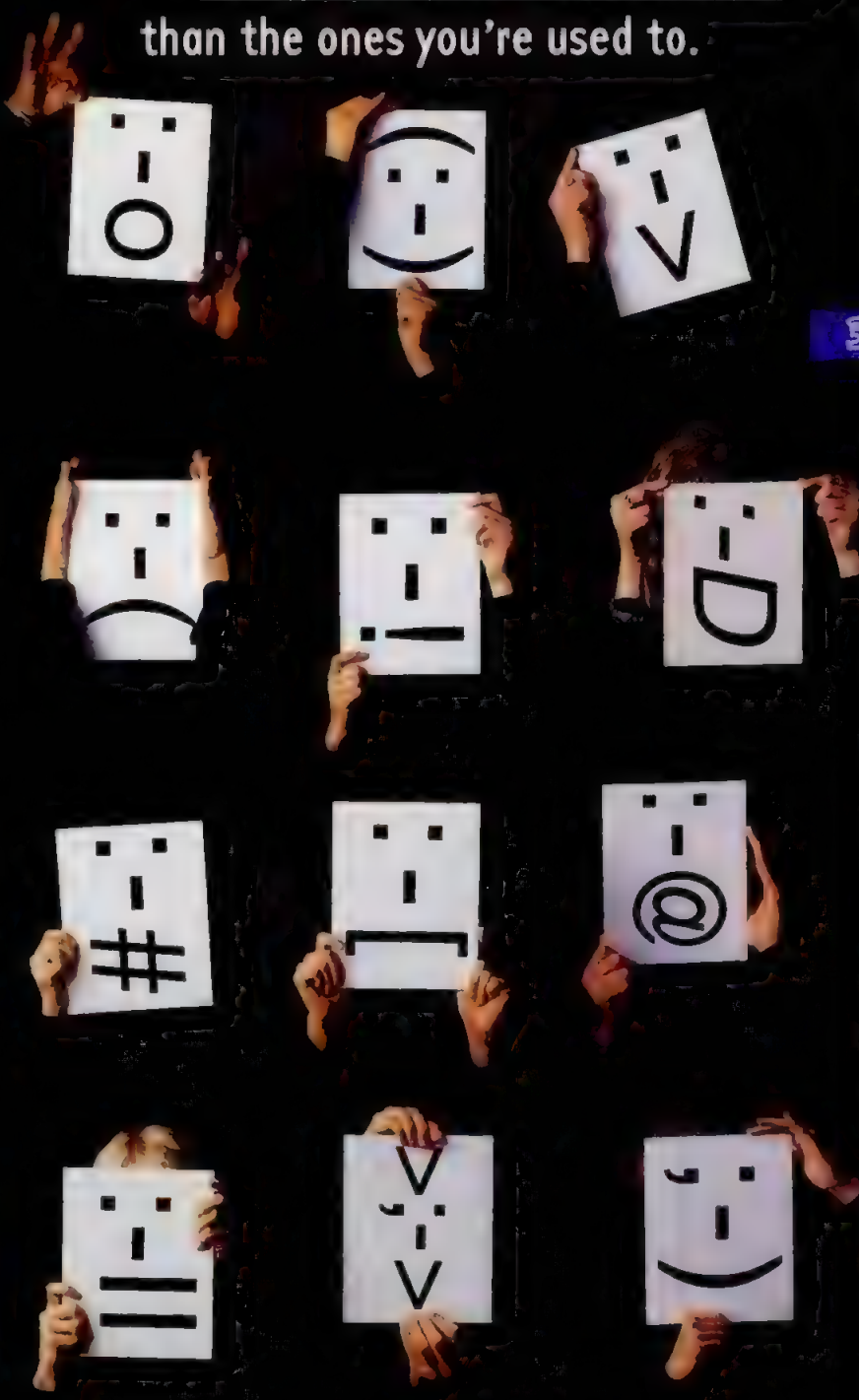
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Letters

OS/2 USERS STIRRED UP OVER JAVA VM

I applaud your roundup of Java Virtual Machines (JVMs), but I disagree with several aspects of your review of the OS/2 JVM ("Your Guide to Java for 1998: Java Environments," April 7). You say: "Upgrading to JDK 1.1 required us to download separate files for the environment and the browser. The environment required a 28MB file download from the IBM site, and the browser required a patch for JDK 1.1 support to be downloaded from the Netscape site." The download for JDK 1.1.1 was 26MB, and the download for JDK 1.1.4 was 30MB. Your article does not specify which you used. You also say that "OS/2 didn't fare nearly as well on our compatibility tests." I don't have your applets to test on my machine. But I run the HotJava browser, ICQ-Java, the Java database program MaxBase, and Innoval's e-mail program without difficulties. I find it hard to believe that sophisticated applications such as these would execute properly if Java compatibility were as poor as you claim.

DAVID T. JOHNSON
via the Internet

You say, "During our initial testing, the Microsoft VM for Windows was unable to display the full contents of the AWT test," followed by "To remedy this, we altered the benchmark test to perform all AWT operations in a separate thread." This is unbelievable. You were willing to modify the tests for Windows but not for OS/2? Why didn't you modify the tests for OS/2 when you came across OS/2 compatibility problems? You made an incredible effort to get the Windows JVM to work but not the OS/2 JVM.

TIMUR TAB
via the Internet

I think your Java compatibility tests were biased against non-Microsoft and non-Windows implementations of Java. Some Java compilers (notably Microsoft's) put ActiveX scripts right into the Java code. Furthermore, Microsoft has created some Windows-specific functions for its JVM. I argue that the incompatibility lies not in OS/2's JVM but in the test code. OS/2's JVM has received the Pure Java stamp of approval from Sun; can Microsoft say the same?

JASON R. STEFANOVICH
via the Internet

As for compatibility, JMark 2.0 is a browser test program, not a test of JVMs as defined by non-Windows users and developers. Your definition of a JVM—that "this environment is created as needed by the browser and doesn't



*"Why didn't you
modify the JVM tests
for OS/2?"*

access the operating system"—is wrong. But your definition is 100 percent compatible with Microsoft's limited, browser-only implementation. On OS/2, I run Java programs from a desktop or folder object or from the command line. This is a robust, fast Java implementation that JMark 2.0 doesn't even test.

TONY DAHLMAN
via the Internet

After our testing, IBM changed the packaging of Java for OS/2 and also issued numerous bug fixes. More important, we did not tailor JMark 2.0 to favor Microsoft IE4. We worked with all the vendors, and none of them saw JMark 2.0 before its public release. No products' scores changed because of any of the fixes we implemented. We have encountered and solved many similar problems with other vendors' browsers throughout development. We mentioned the problem with Microsoft's JVM specifically because it was an interesting problem.

All the environments were tested on browsers. Since IBM insisted that the OS/2 JVM was the same running inside or outside Navigator, there should be no noticeable compatibility differences. All but one of the applications used for compatibility testing are certified 100% Pure Java. In addition, most are available on the Web. JMark is compiled with the standard Java Development Kit (JDK) compiler and has passed the Pure tests. See java.sun.com/100percent/latestlist.html#Z for more information.—Ed.

ENOUGH IS ENOUGH

Michael J. Miller concludes his April 21 column by saying: "The question that remains is

not *whether* Microsoft should be regulated. The question is *how*." First, I am tired of hearing about the monopoly Microsoft has on the software market; it simply isn't true. Microsoft makes great products, which have brought the company terrific success. As a result, they are now targeted for "equalization." The fact that virtually all of the folks at the antitrust hearings used Microsoft OSs might mean something if they weren't generally style-over-substance techno-illiterates. Given the general level of technological sophistication of our government, such a display means nothing. If Microsoft has such a complete monopoly in operating systems, how is it that so many computers are running Linux, MacOS, NextStep, OS/2, and Unix?

JOHN B. WILLISTON
via the Internet

Microsoft does not have a monopoly on the PC OS market. Windows 95 is not the only OS available, nor does Microsoft force people to buy its software. Microsoft does have the largest market share, obviously, but if other companies can write something better, they should go ahead. Miller's comment at the end of the article—that he doubts regulating Microsoft will result in better software or bargains for consumers—is right on the money. Consumers are going to have to suffer with subpar software because the government says Microsoft isn't allowed to play.

JASON LITTLE
via the Internet

THE INSIDE STUFF

I am now on my third SyQuest SyJet 1.5GB SCSI internal drive. It has been replaced twice by the manufacturer in the 18 months since my original purchase. I have also lost five separate 1.5GB cartridges for the SyJet. After about 600MB to 700MB of writing, the disks fail completely—usually becoming completely unusable. I cannot trust the SyJet for anything of importance and am reduced to using it for temporary storage only. Your reviews ("Removable Storage: Your 22 Options," April 21) should have included an examination of how well these media work in practice and how reliable they are for data storage.

FRED FACHET
via the Internet

I would have liked an inside view: What are the technical characteristics of these drives and their media? Are the continually plunging price models merely state-of-the-art hard disks that happen to have removable media cartridges, or are they, as I suspect, a little bit more? Are the stunning price reductions



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Letters

simply the result of technological leaps and bounds, or have the manufacturers built to a price point? Also, with the recent furor about the "click of death" and Iomega's Zip drive, an assessment of the robustness and potential longevity of these devices would be illuminating. Since *PC Magazine* is (and has always been) in the fore of those identifying engineering trends in the computer industry, I expect more in-depth analysis.

DUNC PETRIE
via the Internet

NOT REALLY REAL TIME

There is no such thing as "real time, plain and simple," as John Dvorak says (Inside Track, April 7). "Real time" is never really real-time and certainly never plain or simple. The measure of real-time performance is response latency, with the best by far being real-mode DOS, followed by Windows CE, Windows 3.1, Windows 95, and finally Windows NT. Think of using DOS as flicking your wrist to avoid an obstacle while driving a Formula One racer, compared with tapping on the partition glass to ask the driver of your bulletproof Windows NT limousine: "What was that thump? The champagne jiggled." That sort of immunity from the real world is often more important than real-time response and makes Windows NT an attractive multitasker for conflicting applications, but it is not real-time.

BOB MASTA
via the Internet

WHAT IF OS/2 GETS ATTACKED?

In the April 21 Net Tools article "Can't Say No," you listed a variety of OSs but not OS/2. Why not? It certainly is not a matter of the nonexistence of OS/2 servers. As one of the many OS/2 users, I would surely be interested

How to Contact Us

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that we cannot answer letters individually. To send submissions for PC Solutions, please see the sidebar "How to Contact Us" on the last page of that column.

Corrections and Amplifications

In our April 21 item on the ARCO DupliDisk-PCI (Trends/Peripherals, "RAID for the Rest of Us"), we incorrectly stated that the DupliDisk desktop RAID 1 controller might slow your PC's performance by as much as 50 percent. In fact, since all disk-write signals are sent to both hard disks simultaneously, the DupliDisk-PCI causes no performance hit.

In John C. Dvorak's April 21 column "I Have Seen the Future," the image size of the Viewsonic VPRJ-21408 should have been stated as 300 inches, not 300 feet.

In our April 7 cover story ("Your Guide to Java for 1998: Java Environments"), we incorrectly stated that Netscape 2.02 was the only way to run Java on OS/2. We should have said that Netscape 2.02 was the only Java-capable browser on OS/2 at the time of our testing.

Contrary to the information in the April 7 Second Looks article "ECCO of Discontinuity," NetManaga is not "actively seeking to merge with another company." The article should have stated that NetManaga is "seeking a partner organization interested in continuing the marketing and support efforts of the ECCO Pro product line."

The correct user-license pricing for Stampede Technologies' Remote Office Gold (Trends/Networking, "Away from Home," April 7) is: 10-user increments at \$54.95 per user, 100-user increments at \$39.95 to \$49.95 per user, and 1,000-user increments at \$20.95 to \$38.95 per user.

The correct URL for WebEarly ("The 1998 Utility Guide: Speed Up Browsing," March 24) is www.goto.co.uk.

in the ability of the OS I run to withstand Internet attacks. At each report of a virus or attack, I've tried the test for vulnerability, and so far OS/2 has been unaffected. But I still would like to see information about OS/2 along with other operating systems.

WINSTON F. JENSEN
via the Internet

TROUBLE FINDING ROOTS

I was happy to see a roundup of genealogy programs ("Branching Out," After Hours, April 21), but the article did not say much for your knowledge of genealogy. To any genealogist, the ability to handle sources is imperative. Either the programs you review don't handle sources or they do so clumsily. Family Tree Maker Deluxe, which you gave five stars, gathers dust on my shelf for this reason. Next time you review genealogical software, give a genealogist a call.

JOHN MAYBEE
via the Internet

EQUAL-OPPORTUNITY LAPTOP BAGS?

In response to Bill Howard's column "The Perfect Laptop Bag" (April 7): I've been looking for the perfect laptop bag for years too, and believe me, it's much harder to find when you're a woman. The vast majority of laptop bags are made with businesspeople in mind, along with a few backpack types made for students. I'm neither a businesswoman nor a student, and I hate carrying around an ugly bag that looks like a briefcase. I'm a young mother who has used notebooks for years and travels frequently, and I would love to find a fashionable, feminine, usable laptop bag.

ANGIE BROUGHMAN
via the Internet

As a middle-aged father, I can help you only a bit. I can tell you what my wife and the women on our staff said: The Coach Organizer Brief 532 is gorgeous but not practical (not enough pockets). Try the Hartmann ModemExcel Computer Organizer 512, which looks good in tan nylon and has lots of pockets; the front pouch can be the replacement for your purse's contents, yet it's well sealed, so there's no danger that a dangling cord will yank out the contents of the bag.—Howard

SOFTWARE FALLING ON DEAF EARS

As the father of two hearing-impaired children, I have watched as they are deprived of the full use and enjoyment of several applications. The reason is that more and more software is using voice rather than text to convey information and dialogue.

When a person cannot hear, vocal instruction and information on a PC are useless. Even when there is a face on the screen, the graphics are not sufficiently clear to allow for lipreading. Before voice was as sophisticated as it is now, visible text was routinely included in software, probably because not everyone had sound cards. Well, the hearing-impaired cannot use sound cards of any kind.

Deafness is sometimes a matter of low volume but often of no volume, and without a text interface, games, educational software, and some business software are useless. If nothing else, software publishers should be aware that the hearing-impaired make up a large percentage of the population and will represent an even larger segment as people age and hearing deteriorates.

MICHAEL SOULE
via the Internet

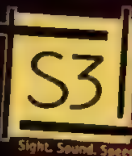
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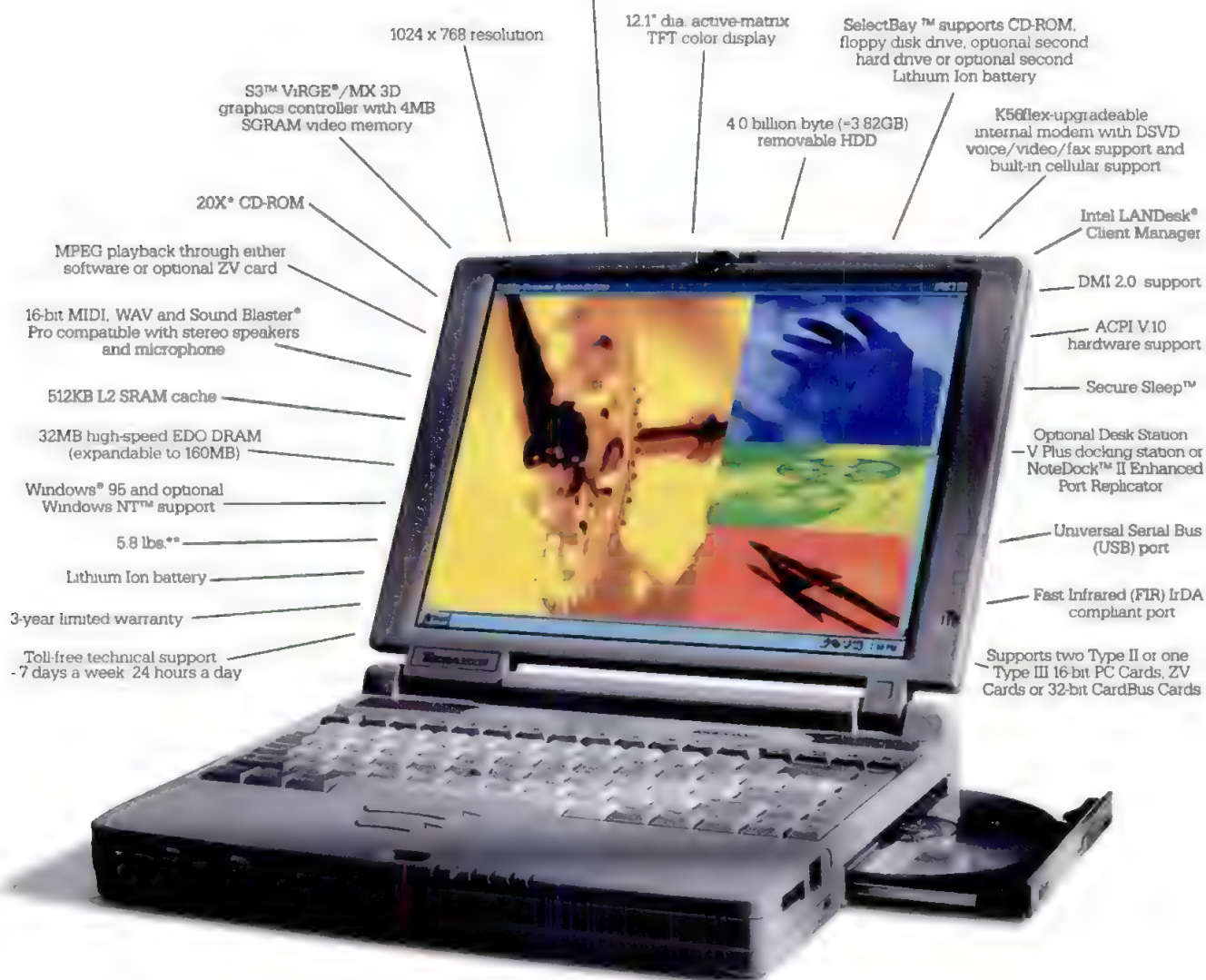


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Trends

A Global Emergency?

As 2000 approaches, some predict panic, while others race for a solution.

The year 2000 is looming, and we're hearing some of the most dire predictions ever to confront the world of computing. The basics are clear: Computers use dates to perform many functions, such as sorting and validating, but most systems have been programmed with date fields reading *mmddyy*—where *yy* represents the last two digits of a year—rather than *mmddyyyy*. Such systems will fail to recognize the final *00* of 2000 properly when January 1, 2000, arrives. In this issue's PC Tech section, *PC Magazine* has taken an in-depth look at the problem (see "Y2K for VB Developers").

According to the doomsayers (and the problem has brought on more than its share of hype), the turn of the century could bring financial meltdown in securities markets, banking and health care crises, military paralysis, airline anarchy, and corporate chaos on a grand scale—all commencing on one day.

"We have the makings of a national emergency on our hands, and I think the year-2000 situation could have an effect on the nation and national security [comparable] to a deliberate, concerted information-warfare attack on the information infrastructure," says Frank Gaffney, assistant secretary of defense during the Reagan administration. He adds that year-2000 breakdowns could make it difficult to move troops to the Persian Gulf and that the military perceives the situation as "computer-geek stuff rather than what real men do at the Pentagon."



INDIFFERENCE REIGNS

Apathy and indifference to year-2000 conversion are running rampant, especially in the corporate world. In a recent Cutter Consortium survey of IT professionals, 91 percent said that their organizations hadn't even produced a budget for year-2000 compliance. Only 21 percent said their companies would guarantee compliance. "There are countless companies out there that are still trying to deny their problems, even internally," says Cutter Consortium's Ed Yourdon.

But not all the predictions are dire. Computer Intelligence has released survey results that

say that large enterprises are, in fact, responding: 54 percent of those surveyed say they have ongoing year-2000 projects, and 17 percent say they have finished such projects.

If you're confused about where to start looking at the problem, one place you can go is the Information Technology Association of America's Web site. This site lists companies whose products are certified to be free of year-2000 bugs, directories of service providers that can identify and resolve such bugs, and links to publications and to legal resources.

WATCH OUTSOURCING COSTS

Year-2000 software conversion may force some organizations to postpone new system development, as staff members work to solve existing problems. In many such cases, the best solution will be to outsource the conversion to a year-2000 service provider. Hundreds exist; the ITAA's site lists nearly 140.

One way to avoid the many overpriced service providers may be to use one of several software tools that help corporations ferret out year-2000 problems. Even if software doesn't solve all problems, it may help identify the magnitude of a given problem. IST Development offers Year 2000 Packs, which analyze network and desktop applications and data. Using the Year 2000 Packs, organizations can audit application files across client/server applications (such as spreadsheets and databases) and across source code generated by programming languages. And ViaSoft offers OnMark 2000 Assess, a \$95 product—appropriate for small businesses—that pays particular attention to spreadsheets, databases, and comma-separated data files.

Whether year-2000 conversion is a crisis or a tempest in a teapot, it will grab headlines for the next year and a half. Market research firm Gartner Group has gone as far as to propose increasing taxes to help pay for the computing aftermath of the turn of the century. According to Microsoft executive vice president Steve Ballmer, though, the total cost of conversion and problem solving has been wildly overstated. Software Productivity Research, for example, estimates a cost of \$3.6 trillion.

Still, Ballmer concedes that "there is a lot at stake for the proper functioning of a number of organizations if the year-2000 issues are not addressed, and there are at least a few high-profile disasters in front of us."—*Sebastian Rupley*

Year-2000 Resources on the Web

The Information Technology Association of America offers an extensive Web site for helping companies make their systems year 2000-compliant



Certified software and hardware vendors
www.itaa.org/2000cert.htm



Conversion service providers
www.itaa.org/script/2000vend.cfm



Success stories
www.itaa.org/success.htm



Publications
www.itaa.org/public.htm



Legal resources
www.itaa.org/Y2Klegal.htm



Congressional hearings
www.itaa.org/congress.htm

Jettison Your Junk E-Mail

Antispammers want ISPs to take action.

Would you open an envelope from someone you didn't know if reading the letter cost you 32 cents? Probably not, because more than likely it wouldn't be worth your time and money. But that's similar to what lots of people who frequent Internet Usenet groups and receive e-mail do on a daily basis. The culprit is spam.

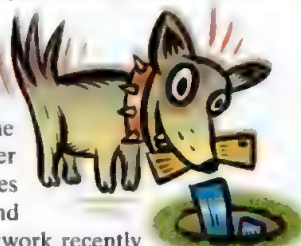
Unlike regular junk mail, spam costs the sender very little.

Rather, the recipient absorbs the expense of the correspondence—which is typically for a commercial solicitation or get-rich-quick scheme—in the form of log-on time and storage. Some industry watchers say spam takes up nearly 40 percent of Usenet bandwidth.

That's too much spam. According to a small but vocal group of antispam crusaders who spend several hours each day deleting offensive missives from Usenet groups, ISPs aren't doing enough to stop spam. The Despammers, as they call themselves, are encouraging ISPs to block spam e-mail, to block IP connectivity from known spam sites, and to use tools such as Apache SPAM Crawler Thwartor to counter programs that spammers use to harvest e-mail addresses from the Web.

Several ISPs are already involved in the fight against spam. E-mail service provider Juno prohibits its subscribers from using the service for transmitting spam. And it maintains a staff to investigate spam-related complaints. In the event that it identifies a spammer, the company terminates the account.

Meanwhile, Whole Earth Networks charges a repeat spammer \$1,000 to reopen an account. Further spamming incidents could result in legal action. If America Online or HotMail learns that a spammer has used one of its addresses, the service provider promptly closes the account. And EarthLink Network recently cofounded an ISP coalition called Internet Service Providers Security Consortium to deal with spam.—*Angela Hickman*



Intel's BX Chip Set: Think Long-Term

AFTER FIVE YEARS, INTEL HAS FINALLY UPGRADED its memory bus. Available with the Intel 440BX chip set, the new 100-MHz bus lets Pentium II processors achieve much higher performance levels.

The inaugural Pentium processor ran internally at the same speed as the chip's interface with main memory, either 60 MHz or 66 MHz. Yet as the Pentium's clock speed rose to 233 MHz, as the Pentium Pro debuted, and as the Pentium II took clock speeds even higher, Intel's memory bus remained unchanged. Processors had reached 333 MHz by January of this year, but they still spoke to their chip sets and memory subsystems at 66 MHz.

When Intel introduced the 350- and 400-MHz Pentium II processors in April, the company discarded its 66-MHz bus and introduced the first 100-MHz memory interface.

For our 400-MHz Pentium II roundup ("400-MHz Pentium II PCs," May 26), we tested nine desktops, each with Intel's fastest processor and latest chip set, the 440BX. With a 350- or 400-MHz Pentium II and 100-MHz-compatible SDRAM, the 440BX runs the system bus at 100 MHz. With previous versions of the Pentium II, it resorts to a 66-MHz bus speed. After benchmark-testing the 400-MHz Micron Millennia Xi 400, we used the system's hardware to examine the abilities of the 400-, 350-, and 333-MHz chips vis-à-vis their system buses.

First we retested the Xi 400 at 350 MHz (after replacing its processor) and 333 MHz (after replacing its processor and ratcheting its bus down to 66 MHz via its motherboard jumpers). Then we removed most of its major components and plugged them into a 333-MHz motherboard based on the

LX chip set. After testing the makeshift system, we compared the LX's extra-bus abilities with the BX's. Our results showed little improvement from LX to BX, system bus aside. The 333-MHz BX system scored 2 percent higher than the 333-MHz LX machine on our ZD CPUmark₃₂ tests (which focus on the processor subsystem) but scored 1 percent lower than the LX system on the ZD Business Winstone 98 tests (which examine performance under Windows).

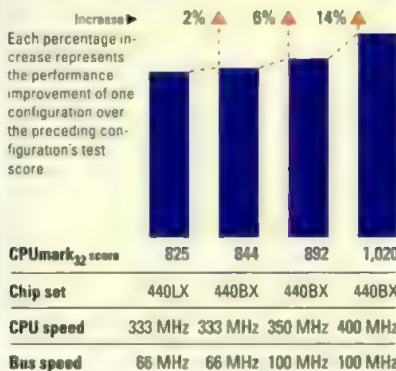
These differences are negligible and may not reflect the two chip sets' relative merits. The definitive comparison is between the 333-MHz and 350-MHz BX systems.

Prior to the 350-MHz version of the chip, Pentium II performance typically increased

at a lower rate than clock speed. The 333-MHz Pentium II has an internal clock 25 percent faster than its 266-MHz sibling's, yet its average CPUmark₃₂ scores were only 20 percent higher in our roundup of 333-MHz machines ("Deschutes Debuts," February 24). Such is not the case with the leap from 333 MHz to 350 MHz. With a faster memory bus, the 350-MHz BX system translated a 5 percent clock-speed increase

The Rise of a New Memory Bus

Intel's new chip set, the 440BX, supports a 66- or 100-MHz memory bus. Though on our tests it showed little performance improvement over its predecessor (the 400LX) when run at 66 MHz, it allowed for greater increases when run at 100 MHz.



into a CPUmark₃₂ gain of nearly 6 percent. Similarly, the 450-MHz BX system—whose clock speed is 14 percent higher than the 350-MHz BX's—produced a CPUmark₃₂ score that was 14 percent higher.

These modest improvements alone can justify buying a BX-based system. If you run data-heavy calculations that create a drag on memory, you have even more reason. Then there's the future to consider: You can't upgrade to new versions of the Pentium II if you purchase an LX machine, since the 333-MHz was the last of a breed. The BX is a fix for now and for later.—*Cade Metz*

Web Policy, Up Close and Personal

Industry execs put Internet privacy and encryption under the microscope.

Some 600 of the PC industry's elite gathered recently at the annual PC Forum to ponder whether new technology will give us more control over private information, how much we can trust other people and companies online unless we know their identities, and whether the government is really here to help us.

"If we don't build systems that governments feel comfortable with," said PC Forum organizer Esther Dyson, "government is going to come in, regulate cyberspace, and do things that people [in the PC industry] feel will be counterproductive."

Echoing that sentiment, Robert Pepper—chief of the Federal Communications Commission Office of Planning and Policy—told the gathering that the personal computing and new-media industries are not being heard in Washington, where institutions such as established telephone companies are shaping the debate on future technologies and

their uses and regulations.

Most of the conference attendees were strongly opposed to government demands to be able to tap into any telephone or Internet transmission. And they opposed restrictions on exporting encryption technology, arguing that U.S. technology isn't much different from what's already available throughout the world. But in the words of panelist Stratton Slavos, president and CEO of VeriSign, the Internet certification firm, "It's easier to argue the FBI's side: 'Terrorists and pedophiles—who wants that?'"

Credit-reporting and direct-mail firms have lots of information about us, and this leads to reams of junk mail and dinnertime phone solicitations. Nick Grouf, CEO of Firefly Net-

work, said, "Today when you give businesses your information, they consider it their property. [In the future,] whenever I choose to share my information, it will fall within the context of informed consent. If I give you information for one purpose, you can't use it for another."

Today computers help us gather information, but it is likely that in the near future, computers might actually help us control information. For instance, when you're making a purchase and you send your background information to an online vendor, you and the vendor could both hold digital keys to the information, and the vendor couldn't sell any data you supply without your say-so.—*Bill Howard*



JAKE KIRCHNER

Looking Forward to the Millennium

Throughout its short, amazing history, the personal computing revolution has been fueled by equal parts innovation and enthusiasm—the enthusiasm of the inventors of the hardware and software and the enthusiasm of the millions of people who have embraced the technology for business and personal use. So it's astounding to me to see so many in this industry down in the dumps about the millennium.

More and more, we're hearing that the technological sweep forward and the financial good times now characterizing the world of personal computing are going to hit a wall as the end of the century approaches. Much of the negative aura surrounding the turn of the calendar to a new century and millennium stems from the year-2000 problem.

The headline-grabbing Y2K fiasco has more than a few folks saying that in bringing the world's computing systems into compliance with the year 2000, IT budgets will lose so much in the way of financial and personnel resources that many users will stop buying hardware, software, and networking products until they can catch their technological breath.

Other disciples of millennium doom and gloom argue that the soaring U.S. stock markets, now powered by the high-tech industries, will hit a wall by the end of next year. They blame this partly on Y2K catastrophes they think we'll see as the clock ticks to 1/1/2000, partly on the general anxiety they think a change of millennium will engender, and partly on a theory that the stock market just can't maintain its fiery pace much longer. But I see just as many reasons to be optimistic about the health of the computer industry



as we go forward into the new millennium.

A year from now, most of the Y2K issues will have been resolved or will be on their way to resolution. This will not be an easy or inexpensive problem to fix. But any company that puts off necessary technology upgrades to focus on Y2K projects will wake up in the new millennium to find itself an also-ran.

As for the stock market—well, who can predict the market? By many estimates and theories, the U.S. market should have tanked a long time ago. If indeed the computer industry is pushing it along, then the market is in good hands. As you'll read in this issue of *PC Magazine*, dedicated to the march of computing into the new millennium, the trend of faster, smaller, cheaper technologies and products has a life of its own and actually accelerates over time. Nothing is going to stop that.

The year-2000 problem is, strictly speaking, not a millennium problem. It's a turn-of-the-century glitch that happens to coincide with the new millennium. Even more strictly speaking, it isn't a turn-of-the-century glitch, because the new century and the new millennium don't technically begin until 1/1/2001. The federal government has neatly sidestepped the issue of the official date by declaring 2000 as the millennial year, allowing for a yearlong celebration by those who embrace either date as the beginning of the millennium.

The coming of a new century is a rare and wonderful thing. A change of millennium is so unusual that only one other has ever occurred in the Western calendar. We ought to be able to experience it with optimism and enthusiasm—especially in the computer business. I know I will.

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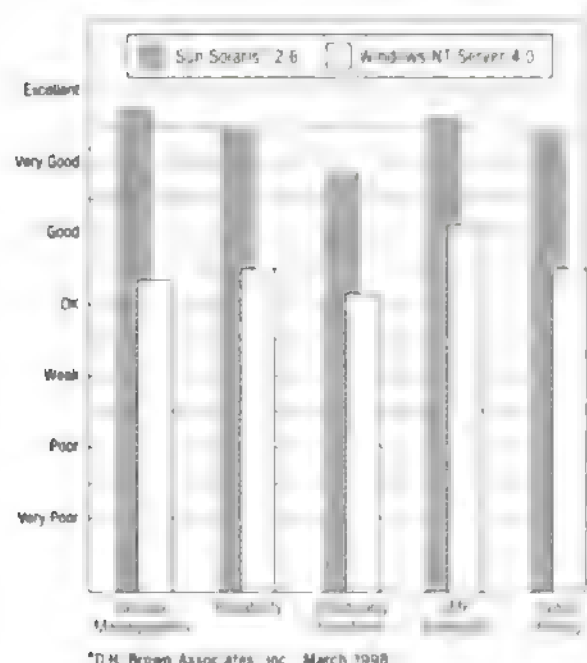


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Whatever you choose to do in the privacy of your own office is your business. But if you rely on a

Microsoft Windows NT Server to run your company's key business applications, the result could be

torturous. In fact, according to D.H. Brown, servers running on Windows NT "continue to fall short of



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The Latest in Home Designs

There was a proverbial sonic boom when Intel recently broke the 333-MHz barrier with its latest Pentiums. Although computer vendors were quick to market with their 350- and 400-MHz business systems, home PCs featuring the latest in Pentium II technology were not far behind.

In addition to increased power, these systems also introduced the Front Side System Bus, which dramatically increases system performance and creates a tempting solution for graphics and video-intensive applications. The Front Side System Bus bumps the bus speed from 66-MHz to 100-MHz—marking the first boost in system bus speed since the Pentium was introduced in 1993. This translates into better support for multimedia features, such as AGP 3-D gaming, photo and graphics editing, voice recognition, DVD, and videoconferencing. As a result, there's a competitive new market segment for top-of-the-line personal computers for the home.

Compaq Computer Corp. (800-345-1518, www.compaq.com), a long-time mainstay in the home market, checks in with its high-end **Presario 4880**, a 400-MHz system tailored for the serious computer enthusiast and hard-core gamer. Housed in a sleek black chassis, the system (\$3,300 street) comes standard with 64MB of SDRAM, a 12GB hard disk, a second-generation DVD-ROM drive, and an ATI 3D Rage Pro AGP graphics card with 4MB of SGRAM video memory. Maximizing its multimedia capabilities, the 4880 offers videoconferencing software driven by Intel's ProShare technology, full-motion video playback, support for MPEG-2, and a 56.6-Kbps

K56flex modem. Another bonus is the inclusion of Compaq's Creativity Imaging Center, a software/hardware combo for connecting a video source to your system for video capture.

Bundled with the system is a wide selection of consumer software packages, among them being Microsoft Works 4.5, Quicken 98, and Wing Commander 4. The price in-



POWER FOR THE HOME: New systems from (clockwise) Quantex, Micron, HP, and Compaq.



cludes a 17-inch Compaq Presario FX700 monitor that has integrated JBL Pro Ported Ultra Base speakers and a microphone jack (pricing without monitor is \$2,600 street). Compaq provides a one-year parts-and-labor warranty, with 90 days of on-site service.

Stepping up to bat with two new home offerings is Micron Electronics (800-642-7678, www.micronpc.com). As with all Micron systems, both the **Millennia 350** and the **Millennia 400** can be customized to meet your needs. The standard configuration of the \$2,229 (direct) Millennia 350 mini-tower includes a 350-MHz Pentium II processor, 32MB of SDRAM, a 4GB Ultra ATA hard disk (an 8.4GB hard disk is a

\$98 upgrade, and a 10GB hard disk is a \$299 upgrade), a 32X CD-ROM, a 56.6-Kbps X2 modem, and a Diamond Viper 330 AGP card. The price includes a 17-inch monitor and Advent 009 speakers (without monitor, the system is \$1,934 direct).

For \$270 more, you can move up to the Millennia 400, a similarly configured system featuring the 400-MHz



CPU. Micron will replace the standard CD-ROM with a DVD-ROM drive with MPEG-2 support for an additional \$150. Both systems come with Microsoft Home Essentials with Power Pak (Microsoft Office Professional 97 is an additional \$199) and a three-to-five year parts, one-year labor warranty.

Also revving up its home line is Hewlett-Packard Co. (800-724-6631, www.hp.com). The **HP Pavilion 8290** (\$2,600 street) mini-tower is packed with a 400-MHz Pentium II processor, 64MB of SDRAM, a 12GB EIDE hard disk, a second-generation DVD-ROM drive, a 56.6-Kbps K56flex modem, MPEG-2 support, Polk Audio speakers, and an ATI Rage Pro 3D AGP graphics card. For an additional \$650 (street), HP offers a 17-inch monitor. The system ships with a carefully selected group of familiar software titles, such as Quicken 98 and Microsoft Encarta 98. The HP Pavilion comes with a one-year warranty

that includes on-site service.

Gateway (800-846-4208, www.gateway.com) ups the ante on its G-Series of multimedia home computers with the **G6-400XL** (\$3,749 direct). This system ships with a 400-MHz Pentium II processor, 128MB of SDRAM, and a whopping 14.4GB hard disk. Other components are: an nVidia AGP graphics card with 4MB of SGRAM, a second-generation DVD-ROM drive, Boston Acoustic Media Speakers, and a 19-inch monitor. Microsoft Home Essentials 98 is part of several optional software bundles. Gateway provides a three-year parts-and-labor warranty, and a year of on-site service.

Direct vendor Quantex Microsystems (800-346-6572, www.quantex.com) has two new home systems: **0P6/350 M-4x SE** (\$1,999 direct) and the more advanced **0P6/400 M-4x** (\$2,499).

The M-4x SE uses the 350-MHz processor and includes such features as a 4.3GB Ultra ATA hard disk, 64MB of SDRAM, a Toshiba MPACT2 3D Media Accelerator graphics card, a 32X CD-ROM drive (a second-generation DVD-ROM drive is a \$199 upgrade), a 56-Kbps K56flex modem, and a 17-inch monitor.

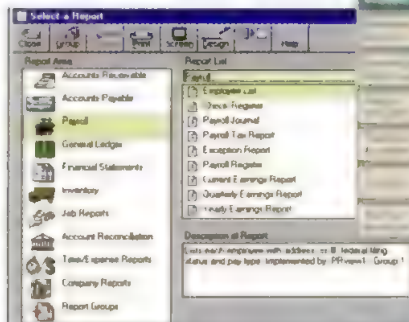
At the next level, the M-4x adds a 400-MHz processor, an 8.4GB Ultra-ATA hard disk, 64MB of RAM, an Intel 740i AGP graphics card with 8MB of SDRAM, a 32X CD-ROM drive (DVD-ROM upgrade is \$199), and a 19-inch monitor. Both systems include Altec Lansing speakers, but in contrast to all of the other systems listed here, the Quantex systems have only software and not hardware MPEG-2 support. Quantex's standard software bundle features Corel WordPerfect Suite and Compton's Interactive Encyclopedia. A three-year parts, one-year labor warranty with one year of on-site service is included. —Simon Eskow

RECAP PC Magazine evaluated the first nine 400-MHz Pentium II systems to hit the market in our issue of May 26, 1998. The Gateway G6-400 was awarded Editors' Choice.

ACCOUNTING SOFTWARE

Multiuser Accounting

Small organizations with up to 100 employees comprise the vast majority of today's businesses. Accordingly, accounting software vendors are introducing feature-rich, multiuser versions of their products.



Intuit takes its flagship product—**QuickBooks Pro 6.0**—to the next level by adding full 32-bit support as well as multiuser functionality (800-446-8848, www.quickbooks.com). The multiuser version is priced at \$599 for a five-user value pack; the more basic version that lacks support for multiple users sells for \$220 (street).

QuickBooks Pro continues to offer its EasyStep Interview and QuickBooks Navigator, and adds new features that help even neophytes get up and running without a struggle. The revamped help system includes "How Do I" buttons that provide context-sensitive help throughout the program, and help menus, which are accessible via the right-mouse button. Upon installing QuickBooks Pro, former users of QuickHome and Business can import their data into QuickBooks with a single mouse click.

This multiuser-ready package also comes with an array of features that help managers make the most of the software's capabilities. The setup wizard, for example, simplifies the task of setting up multiple users with varying access privileges and individual passwords. You can then allow each user to customize individual pref-

erences, such as the icon bar, menus, and audio effects, or you can set company-wide preferences. With multiuser tracking, any user can see who is logged on



MULTIUSER ACCOUNTING: New packages from Peachtree (left) and Intuit.

to QuickBooks at that moment, and managers can use the Audit Trail feature to track any changes to transactions and reports. For accounting purposes, close dates can be set and password protected to prevent anyone from accidentally altering the data from a closed accounting period.

QuickBooks Pro now also provides new online banking and bill payment services and the ability to generate payroll and unbilled costs by job reports.

Peachtree Software (800-228-0068, www.peachtree.com) has also upgraded its core product with multiuser functionality. **Peachtree Complete Accounting for Windows 6.0** (\$200 street) is intended for small businesses that manufacture or sell products; for businesses that operate in the professional services market, Peachtree adds billing functionality in **Peachtree Complete Accounting Plus Time and Billing 6.0** (\$250 street).

Peachtree Complete Accounting provides a variety of multiuser accounting and business management tools. And, in an aggressive move to convert Intuit customers, Peachtree offers rebates for current users of QuickBooks and Quicken, as well as a simple tool for importing data from QuickBooks.

To simplify navigating the program, there are a host of new navigational aids, which provide help and direct access to common features. One new option, Accounting Behind the Screens, allows you to hide or view calculations that are performed automatically.

The Hide General Ledger Accounts option lets you decide if you want to close the General Ledger view to cre-

ate a cleaner environment for beginners.

Among the standard tools are purchase and sales orders, job costing, and project tracking. Another tool, Memorized Transactions, a feature that automates repeated activities such as monthly payments.

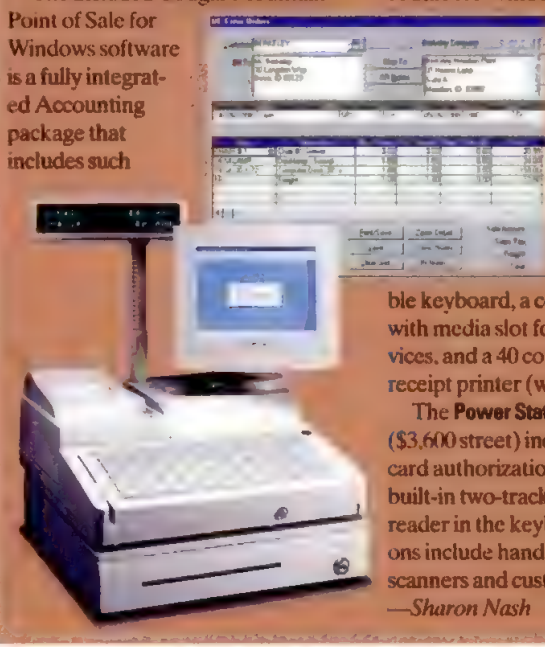
An essential part of Peachtree Complete Accounting is its newly enhanced multiuser capabilities, which let small businesses add multiple users to their network easily, free of charge. Multiple users can now work in the same file simultaneously. To ensure security, business owners can use the program's screen-level password security to protect private information, and they can also determine user access to information. Meanwhile, the Audit Trail allows businesses to monitor changes to transactions and employee activity.—*Matthew Graven*

A Complete Sales Solution

Billing itself as a fully integrated point-of-sale (POS) hardware and software solution, the **Point of Sale Power Station 3000** series (starting at \$3,000 street) is now available from Cougar Mountain Software (800-388-3038, www.cougarmtn.com).

The included Cougar Mountain Point of Sale for Windows software is a fully integrated Accounting package that includes such

components as Point of Sale, General Ledger, Inventory, Accounts Payable, and Accounts Receivable (a DOS version is also available). The product also comes with Data Exchange for easy import and export of data to and from the program. Point of Sale for Windows features cus-



tomizable entry screens for ease of use and learning. The standard hardware for each system is a 9-inch monochrome SVGA monitor, a 112 key programma-

ble keyboard, a compact cash drawer with media slot for additional devices, and a 40 column dot matrix receipt printer (with Star emulation).

The **Power Station 3000 Plus** (\$3,600 street) includes credit-card authorization software and a built-in two-track magnetic card reader in the keyboard. Other additions include hand-held bar code scanners and customer displays.

—*Sharon Nash*

4 OUT OF 5 GEEKS CHOOSE MICRON

(THE FIFTH PROBABLY BUILDS THEIR OWN)

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- Wavetable/3D Surround Sound

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Transport Trek is thin and light at
as little as 6.2 lbs and 1.7" thin



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active matrix display
- powered by 128-bit
graphics accelerator

Everything You Need

Modular Bay that accepts variable 20X CD-ROM
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Powered by the 233 or 266MHz
mobile Pentium® processor with
MMX™ technology



THE NEW TRANSPORT TREK - RANKED #1 BY PC WORLD

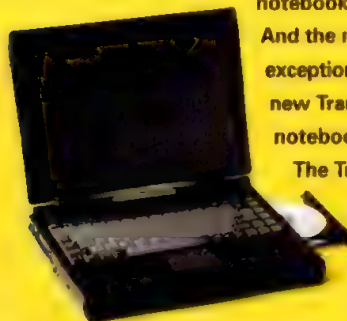
*"The TransPort Trek is the fastest budget
notebook we've run through our mill"*

-PC World, Ranked #1 April '98

Geeks, experts and industry pundits all agree that Micron
makes the world's best notebooks. We've won the coveted
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And the new TransPort Trek is no
exception. PC World just ranked the
new TransPort Trek the #1 budget
notebook available today.

The TransPort Trek is the single
best desktop replacement
notebook you can buy.



Transport Trek Apr '98

TransPort® Trek™

Common Features on all TransPort Systems:

- 512KB L2 pipeline burst cache
- PCI bus with 128-bit graphics accelerator
- USB, parallel, serial, VGA, PS/2, ports
- S-Video Out; MPEG compatible
- CardBus and Zoomed Video ready
- Wavetable/3D Positional sound
- Microphone, stereo line-in & line-out jacks
- 2 Type II or 1 Type III PCMCIA slots
- 20X modular CD-ROM drive
- 2-way infrared port
- Touchpad pointing device
- Modular floppy drive
- Li-Ion battery
- Choice of Portable Software Solutions Pak
- Microsoft® Windows® 95 and Microsoft Plus!
- 5-year/1-year Micron limited warranty

Trek 233

- 233MHz Intel Pentium processor with MMX technology
- 32MB EDO RAM
- 2.1GB hard drive
- 12.1" SVGA TFT display

\$1,999

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Trek 233

- 233MHz Intel Pentium processor with MMX technology
- 32MB EDO RAM
- 2.1GB hard drive
- 13.3" XGA TFT display
- Microsoft Office Small Business Edition

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Trek 266

- 266MHz Intel Pentium processor with MMX technology
- 32MB EDO RAM
- 3.2GB hard drive
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- Microsoft Office Small Business Edition

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Modular bay that accepts variable 24X CD-ROM drive & a 3.5" floppy (both included); and up to 3 hour bay battery (included)

Micron™ GoBook™ is just 1.35" thin and weighs as little as 4.4lbs



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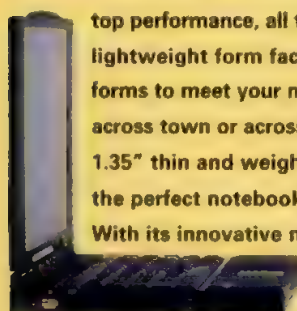
"The GoBook is the notebook by which all others will be measured in 1998!"

Thanks to GoBook, you don't have to compromise anymore.

Now you can have a notebook with insane battery life,

top performance, all the features and a cool, thin, lightweight form factor in a notebook that transforms to meet your needs - whether you're heading across town or across the Pacific. Starting at just 1.35" thin and weighing just 4.4lbs - the GoBook is the perfect notebook for the mobile professional.

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GoBook

Common Features on All GoBook Systems:

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- 512K L2 pipeline burst cache
- 12.1" SVGA display
- PCI bus with 128-bit graphics
- USB, parallel, serial, VGA, PS/2, NTSC/S-Video, ports
- S-Video Out; MPEG compatible
- CardBus/Zoomed Video ready
- 16 bit stereo/Wavetable sound
- Microphone, stereo line in/out jacks
- 24X modular CD-ROM drive
- 2 Type II or 1 Type III PCMCIA slots
- 2-way infrared port
- Touchpad pointing device
- Modular floppy drive
- Norton Anti-Virus & System Wizard
- Microsoft® Windows® 95 and Microsoft Plus!
- 5-year/1-year Micron limited warranty*

GoBook 233

- 233MHz Intel Pentium processor with MMX technology
- 32MB EDO RAM
- 2.1GB hard drive
- Super base battery
- Bay battery
- Microsoft Office Small Business Edition

\$2,599

Bus. Lease \$89/mo

GoBook 233

- 233MHz Intel Pentium processor with MMX technology
- 32MB EDO RAM
- 2.1GB hard drive
- Super base battery
- Bay battery
- Microsoft Office Small Business Edition

\$2,999

Bus. Lease \$102/mo

GoBook 266

- 266MHz Intel Pentium processor with MMX technology
- 32MB EDO RAM
- 2.1GB hard drive
- Super Base battery
- Bay battery
- Microsoft Office Small Business Edition

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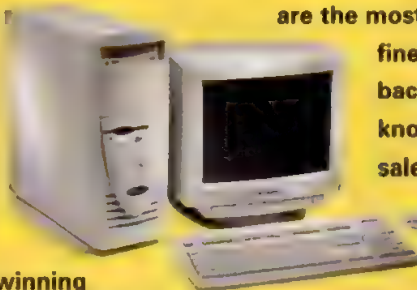
Technology freaks unite. The Millennia® 400 is a multimedia dream machine. Whether you have big ideas for audio, video, publishing or are in the market for the ultimate gaming machine, there's no system more ideal for what you need and no system more ready to meet your needs in the future. The Micron™ Millennia desktop line, long a favorite among industry pundits and experts, offers the latest in technology all at factory direct prices that lead the industry.

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MICRON - RANKED #1 IN TOTAL CUSTOMER SATISFACTION BY THE READERS OF PC WEEK

Micron is so popular among the tech savvy set that the readers of *PC Week* just voted Micron #1 in overall

customer satisfaction. Four out of five PC geeks (the fifth probably just builds their own) prefer Micron because they recognize Micron's engineering driven, award-winning



product focus is unmatched in the PC industry. They also know that Micron systems are the most dependable. Micron uses the

finest quality components that are backed up by our responsive and knowledgeable tech support and sales force - all at prices that you wouldn't expect to find from a top-tier \$2 billion direct systems manufacturer.

Millennia 333

- Intel 333MHz Pentium II processor
- 32MB SDRAM
- 4.0GB Ultra ATA hard drive
- 17" Micron 700Gx, .26dp monitor (16" display)
- 82440LX chip set
- 512KB internal cache, 2MB flash BIOS
- 3.5" floppy drive
- 32X EIDE variable speed CD-ROM drive
- 128-bit AGP Diamond Viper V330 (nVidia), 4MB EDO SGRAM & MPEG
- Integrated 32-voice wavetable 3D stereo sound
- Advent AV009 stereo speakers
- 56K x2 data/fax modem*
- 104-key enhanced keyboard
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- Microsoft Windows® 95 and Microsoft Plus!
- Microsoft Office 97 Small Business Edition
- 5-year/3-year Micron Power™ limited warranty

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- 64MB SDRAM
- 6.4GB Ultra ATA hard drive
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- DVD-ROM drive and PCI decoder card***

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Millennia 350

- Intel 350MHz Pentium II processor
- 32MB PC100 SDRAM
- 4.0GB Ultra ATA hard drive
- 17" Micron 700Gx, .26dp monitor (16" display)
- 82440BX chip set
- 512KB internal cache, 2MB flash BIOS
- 3.5" floppy drive
- 32X EIDE variable speed CD-ROM drive
- 128-bit AGP Diamond Viper V330 (nVidia), 4MB EDO SGRAM & MPEG
- Integrated 64-voice wavetable 3D stereo sound
- Advent AV009 stereo speakers
- 56K x2 data/fax modem*
- 104-key enhanced keyboard
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- 8.4GB Ultra ATA hard drive
- Integrated 100MB Iomega Zip drive / 3.5" floppy drive
- DVD-ROM drive and PCI decoder card***

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Millennia 400

- Intel 400MHz Pentium II processor
- 32MB PC100 SDRAM
- 4.0GB Ultra ATA hard drive
- 17" Micron 700Gx, .26dp monitor (16" display)
- 82440BX chip set
- 512KB internal cache, 2MB flash BIOS
- 3.5" floppy drive
- 32X EIDE variable speed CD-ROM drive
- 128-bit AGP Diamond Viper V330 (nVidia), 4MB EDO SGRAM & MPEG
- Integrated 64-voice wavetable 3D stereo sound
- Advent AV009 stereo speakers
- 56K x2 data/fax modem*
- 104-key enhanced keyboard
- Microsoft IntelliMouse
- Microsoft Windows 95 and Microsoft Plus!
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- 5-year/3-year Micron Power limited warranty

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- 64MB PC100 SDRAM
- 8.4GB Ultra ATA hard drive
- Integrated 100MB Iomega Zip drive / 3.5" floppy drive
- DVD-ROM drive and PCI decoder card***

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- 2+1 (3 total) 360 Watt each
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THE NEW NETFRAME 3100 SETS A NEW STANDARD FOR ENTRY-LEVEL PC SERVERS.

While fully loaded systems aren't always needed at first, the ability for a server to grow as your business grows is critical. The new NetFRAME® 3100 provides that upgrade path. It incorporates mid-range features like hot swap hard drives, convenient remote management technology and a highly



integrated motherboard. It also features the 440BX chip set -- Intel's latest chip set technology supporting 100MHz front side bus and 100MHz SDRAM. Combined with the fastest processors available, this server offers networked businesses the performance of a dependable mid-range server at an entry-level price.

NetFRAME LV2000 Small Business Server Edition

- Intel 233MHz Pentium II processor
- Dual processor capable
- 64MB ECC SDRAM
- 4GB Ultra-Wide SCSI-3 hard drive
- Microsoft® Small Business Server 4.0 (10 user license)
- NOS support (3 first-year incident resolutions), 7x24
- 512KB integrated L2 ECC cache
- 5 expansion slots: 4 PCI, 1 ISA
- Integrated Adaptec PCI Ultra-Wide SCSI-3 controller
- Intel EtherExpress Pro 100 network adapter
- 56Kbps x2 US Robotics modem*
- Upgradable to 36GB storage
- 32X EIDE CD-ROM drive
- Intel LANDesk® Server Manager
- Dedicated server technical support, 7x24
- 5-year/3-year Micron Power™ limited warranty
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\$4,032

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NetFRAME 3100

- Intel 350MHz Pentium II processor
- Dual processor capable
- 64MB ECC 100MHz SDRAM
- 4GB Ultra-Wide SCSI-3 hard drive
- Microsoft® Windows NT® Server 4.0 (10 user license)
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- Intel 440BX PCI chip set
- 512KB integrated L2 ECC cache
- 100MHz front side Bus
- Integrated Symbios Ultra-Wide SCSI-3 dual channel controller
- RAID capable
- 5 expansion slots: 3 PCI, 1 ISA, 1 shared PCI/ISA
- 8 drive bays: 1 external 3.5", 2 external 5.25"
- 5 hot-swap hard drive bays
- 32X EIDE CD-ROM drive
- Integrated SVGA graphics (2MB)
- Integrated Intel 10/100 Ethernet
- Intel LANDesk Server Manager
- Dedicated server technical support, 7x24
- 5-year/3-year Micron Power limited warranty
- 1-year next-business-day on-site service**

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NetFRAME MV5000

- Intel 233MHz Pentium II processor
- Dual processor capable
- 64MB ECC SDRAM
- 4GB Ultra-Wide SCSI-3 hard drive
- Microsoft Windows NT Server 4.0 (10 user license)
- NOS support (3 first-year incident resolutions), 7x24
- 512KB integrated L2 ECC cache
- Memory: ECC, EDO or SDRAM option
- 9 expansion slots: 6 PCI, 2 ISA, 1 shared ISA/PCI
- Dual Integrated Symbios Ultra-Wide SCSI-3 controller, 1 narrow
- Intel EtherExpress Pro 100 network adapter
- 32X EIDE CD-ROM drive
- RAID capable
- 5 internal, hot-pluggable, hard drive array bays (upgradable to 10)
- One 360-watt hot-pluggable power supply standard (upgradable to 3 for added redundancy)
- Intel LANDesk Server Manager
- Dedicated server technical support, 7x24
- 5-year/3-year Micron Power limited warranty
- 1-year next-business-day on-site service**

\$4,599

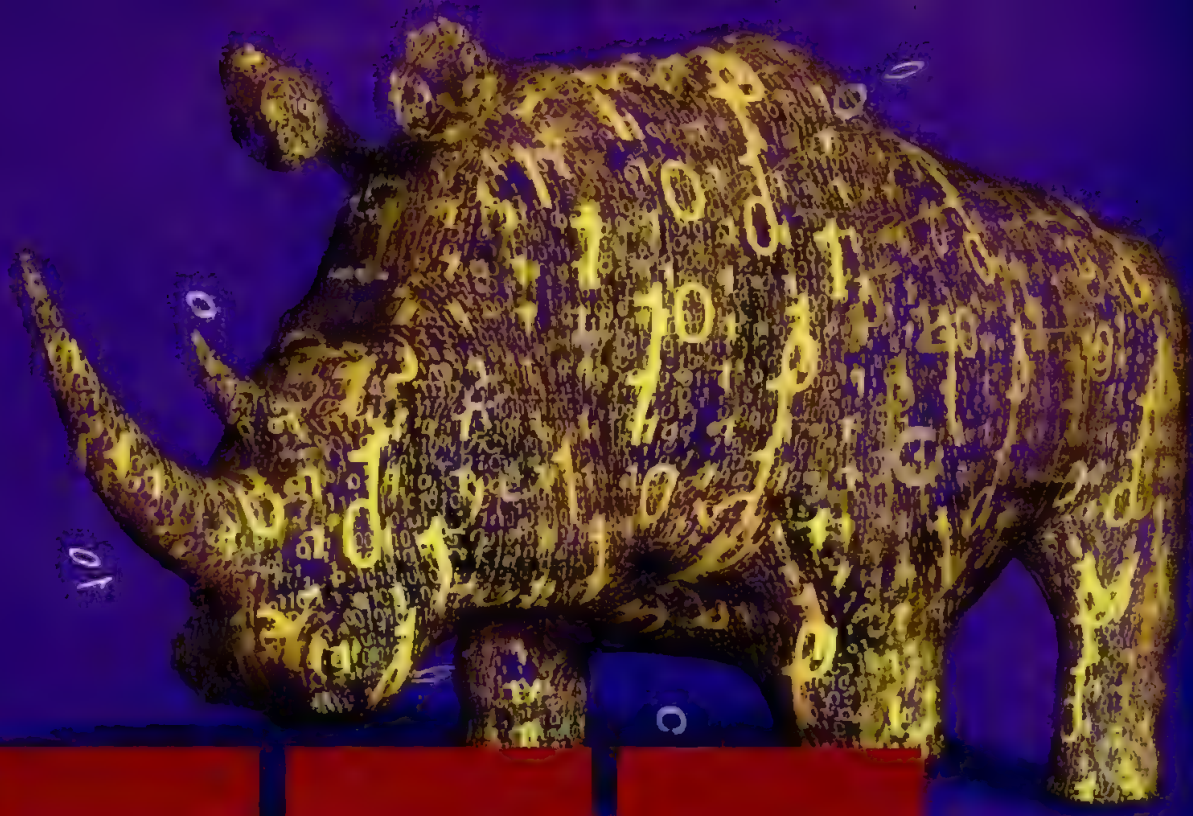
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GRAPHICS CARDS

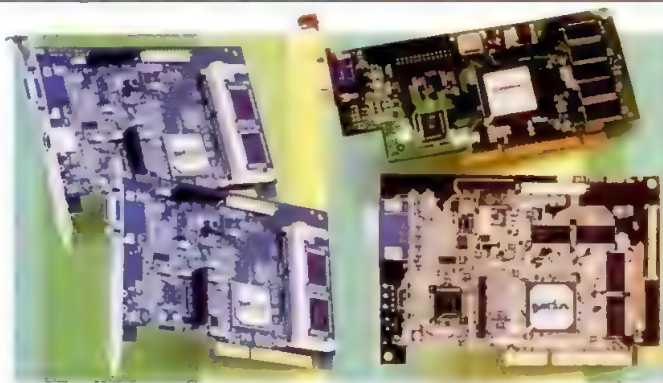
3-D for Office and Home

With a deluge of new mainstream graphics cards available this year, choosing which product to buy has become a tough decision. Take a look at these latest offerings, which raise the bar for performance and features while maintaining affordable price points.

Matrox Graphics (800-361-1408, www.matrox.com/MGA) offers several new AGP cards, each catering to a different market. For the business user, the 8MB **Productiva G100** (\$100 street), which is built around Matrox's new 2-D/3-D MGA-G100 chip, delivers 24-bit true color at resolutions up to 1,600 by 1,200. A 230-MHz integrated DAC provides refresh rates up to 85 Hz at 1,600 by 1,200. You can upgrade the G100 with Matrox's DVD Video (\$80 street), a daughtercard that provides hardware-accelerated MPEG-2 video playback.

Also aimed at business users is Matrox's 2-D and 3-D **Millennium G200**. Available in 8MB (\$230 street) or 16MB (\$330 street) versions, this card is based on the MGA-G200 chip and includes an integrated 250-MHz DAC with 128-bit DualBus architecture. The 8MB model supports a maximum 1,920-by-1,080 resolution with 24-bit color at a 75-Hz refresh rate, while the 16MB version generates 1,920-by-1,200 resolution with 24-bit color at 75 Hz.

For the 3-D game and home market, Matrox offers the **Mystique G200** (\$230 street for 8MB, \$330 street for 16MB). This 2-D/3-D card integrates a 230-MHz DAC with 128-bit DualBus architecture. The 16MB version can achieve display resolutions as high as 1,920-by-1,200 while maintaining a refresh rate of 75 Hz. 3-D gamers benefit from the card's use of



PIXEL POWER: (Counterclockwise from top left) Matrox's *Mystique*, *Productiva*, and *Millennium*; the *Diamond Stealth II*.

Symmetric's Rendering Architecture, which allows the MGA-200 to work in parallel with the CPU to boost performance.

New from Diamond Multimedia Systems (800-468-5846, www.diamondmm.com) is the **Stealth II G460**. An 8MB AGP 2X card powered by the new Intel i740 graphics controller, the Stealth II (\$150 street) can handle 24-bit color at resolutions up to 1,280-by-1,024. The card supports 1,024-by-768 resolution at

an 85-Hz refresh rate and is based on hyper-pipelined 3-D, a parallel data-processing architecture that boosts graphics pipeline efficiency by off-loading many processes to the CPU. The Intel accelerator also provides precise-pixel interpolation for the enhancement of visual effects as well as direct memory execution for quick storage and execution of larger 3-D textures using system memory.

Canopus Corp. (408-954-4502, www.canopuscorp.com) now has an AGP version of its **\$229 Total3D 128V** card. Based on the hot nVidia RIVA 128 2-D/3-D chip, the card has a 230-MHz DAC and 4MB of 100-MHz SGRAM, and supports resolutions up to 1,600 by 1,200 at a refresh rate of 85 Hz. The Total3D features video-in capability for video capture and live display on the desktop.

Targeted at gamers, the **Righteous 3D II**, the latest offering from Orchid Technology (800-577-0977, www.orchid.com), is a PCI card based on 3Dfx Interactive's Voodoo2 graphics chip set. The card is available in 8MB and 12MB memory configurations and is priced at \$249 and \$299, respectively. The Righteous 3D provides resolutions of up to 1,024 by 768, although resolution with Z-buffering goes up only to 800 by 600. The card has a 90-million pixel-per-second fill rate, with rendering at up to 3 million triangles per second.—Roderick A. Beltran

Move Over, Videotape

Is video editing on the PC the next killer application? With today's easy-to-use hardware and software bundles, business users can create in-house training videos—and home users can condense hours of tedious home videos into a short film that contains just the entertaining highlights, complete with transition effects, title screens, and background music. And best of all, the technology is surprisingly affordable.

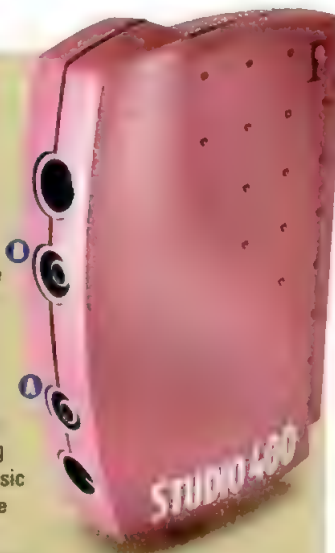
Priced at \$229, the **VideoDirector Studio 400** from Pinnacle Systems (650-526-1600, www.pinnaclesys.com) is the follow-up to the company's excellent VideoDirector Studio 200, a 1997 *PC Magazine* Technical Excellence Award finalist. Studio 400 captures video directly from your camcorder tapes or VCR and lets you edit in sound, text, and title screens; you can then record your edits back onto VCR videotape with no loss of quality.

The main hardware component is an external Studio Mixer module that connects to your PC's parallel port. This device feeds low-res versions of your video to the PC so that you can create a storyboard, add visual effects, and preview the results before committing your production to tape. The included serial port cable connects your PC, VCR, and camcorder together, so there's no need to add an internal card to your PC.

THAT'S A WRAP: Studio 400 lets you (A) input video from your camcorder to your PC, and then (B) output edited video back to your VCR.

Adding video and audio effects is easy, as is selecting the background music and tailoring it to the length of a scene.

Studio 400's software uses an off-line editing process that lets you view an Intel Indeo-compressed version of your movie. Since you need to wait as your camcorder finds the proper scenes and sends them to your VCR, recording the finished product takes longer than with other packages. But this process conserves hard disk storage space: One hour of video requires only 150MB, versus the 12GB that would be needed to record to and from disk.—Josh Levy



WEB GRAPHICS TOOLS

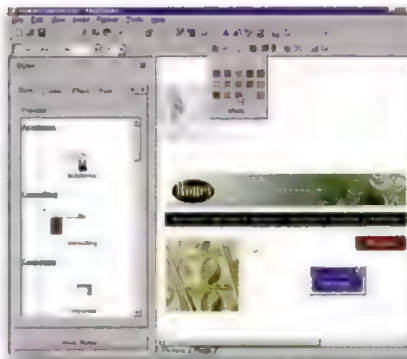
Web Site Aesthetics

So you want an eye-catching Web site that will attract more business but you feel insecure about your abilities as a graphic artist and site builder. Try one of these utilities, any of which can help you create a gem of a site that will stand out on the Web.

From NetStudio Corp. (510-644-9700, www.netstudio.com), **NetStudio 1.0** is a Web graphics creation tool designed for nonartists. The product, which will be priced between \$100 and \$200, lets you apply designed styles to entire Web pages as well as individual pictures for automatic formatting. NetStudio allows for one-click in-

sertion of graphics and effects into your Web page; you just choose from one of the many integrated options such as buttons, navigation bars, and banners. A Web view option lets you preview your page and make any changes you desire.

Creating your graphics is important, but you also want to make sure they're optimized for the Web. Raspberry Hill's (973-579-7994, www.gifwizard.com) **GIF Wizard** goes through a Web site and scans for GIF and JPEG images that are bloated and proceeds



EASY ART: NetStudio is aimed at nonartists working on a Web site.

to compress them. The \$14.95 version of the product allows you to click on graphics individually to compress them. The higher-end \$399 version includes Site Scan, which scans an entire Web site. —Roderick A. Beltran

Windows Scripting Host in the upcoming Windows 98 and NT 5.

Another freeware product due in the coming months is **PerlEx**, which is like The Apache Group's (perl.apache.org) **mod_perl** for the Apache Web Server. PerlEx significantly enhances performance by running Perl as part of the Web server. Also expected is ActiveState's **Visual Perl**, a fully integrated development environment that lets you re-

motely debug Perl when running the software on any Perl system, including Unix systems that support sockets.

Win32 Perl users will appreciate the forthcoming Windows NT version of ActiveState and O'Reilly Associates' **Perl Resource Kit** (707-829-0515, www.oreilly.com).

The kit is a comprehensive set of Perl documentation, software, and standard modules for the language. The Win32 kit promises to offer a host of commonly used Perl modules that run smoothly on Win32 Perl. Both versions (Windows NT and Win32) are priced at \$149.95. —Larry Selzer

WEB SITES

Play Ball!

If you're stuck in front of the computer instead of the TV on the night of the big game, that doesn't mean you have to miss out on all the fun. Check out these online services that provide up-to-the-minute statistics and coverage while games are being played.

On **ESPN GameCast** (www.espn.com), baseball fans can get pitch-by-pitch updates and continually updated graphics of player and game stats. A Diamond View graphic of a baseball



BATTER UP: ESPN's GameCast lets you keep track of every aspect of a game via your computer.

field shows you if there are runners on base, who's in the field, and also gives statistical information about the players. The free feature is accessed via the baseball scoreboard section of ESPN's site.

In the meantime, NBA.com's **Courtside Live** (www.nba.com/games9798/aboutcourtside.htm) provides similar features for NBA basketball games. Perfect for the play-off season, Courtside Live gives you the latest shot charts, tracks every player's shots, instantly refreshes statistics, and offers live coverage. Courtside Live is free and even posts personalized alerts when key game events occur, such as when a certain player scores or when a lead change takes place. —Doug Beizer

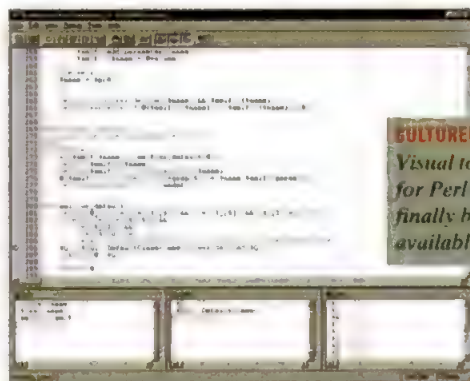
PROGRAMMING

Perl on Win NT Grows Up

One of the most popular ways to write programs to run on Web servers is using the Perl programming language. Perl and the Web were both born in the same Unix-dominated culture, and Perl quickly became the preferred language for Common Gateway Interface (CGI) programming. But the close links between Perl and Unix made Windows NT implementations of Perl secondary and hindered the use of Windows NT for many Web server applications.

ActiveState Tool Corp.'s recently released **Perl Debugger** is a Perl product that stands out from the usual dull-looking Unix ports (www.activestate.com). The debugger, which costs \$95 for a single-user license, is the first true visual tool for Perl. The product has all the basic features found in Graphical User Interface (GUI) tools for other languages, including breakpoints and watches, syntax coloring, and dumps of structures in Perl-oriented formats.

ActiveState offers a collection of binary freeware **Perl for Win32** products, including the company's Win32 Perl interpreters, used for running programs written in the Perl language. Apart from the conventional Win32 version, **Perl for ISAPI** lowers the overhead of



CULTURED PERL: Visual tools for Perl are finally becoming available.

running Perl on Microsoft's Internet Information Server (IIS) and other ISAPI-compatible applications. Also available for free is **PerlScript**, an Active Scripting version of Perl that runs in any Active Scripting environment, including Internet Explorer 4, Active Server Pages, Exchange 5.5, and the

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★ EDITORS' CHOICE ★

The AMS Tech Rodéo 5030ECX won Editors' Choice in a test of 21 top-of-the-line notebook computers. The Rodéo 5030ECX finished first in the BAPCo SYSmark32 suite, which tests real-world business applications and came in second in the Intel Media Benchmark suite, which tests multimedia performance.

Computer Reseller News
February 2, 1998

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5020ECX	233MHz Pentium® Processor	4.0GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3795.00
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3037CX	266MHz Pentium® II Processor	4.0GB HDD	64/128 MB RAM	13.3" XGA TFT	56K Modem	24X CD-ROM	\$3195.00
3035CX	266MHz Pentium® Processor	3.1GB HDD	32/128 MB RAM	13.3" XGA TFT	56K Modem	24X CD-ROM	\$2995.00
3030ECX	233MHz Pentium® Processor	4.0GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3095.00
3020ECX	233MHz Pentium® Processor	3.1GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$2995.00
3015ECX	233MHz Pentium® Processor	2.1GB HDD	32/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$2895.00

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NETWORK MANAGEMENT

An Eye on Your Network

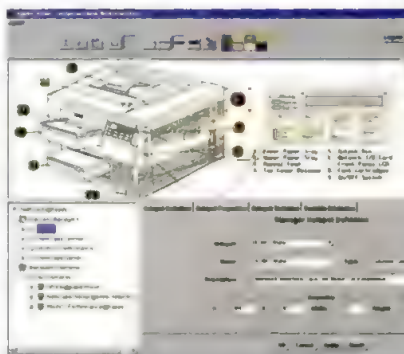
Keeping a large network up and running is a formidable task. Two new network management products, each offering a different approach, can now assist with this task. One solution, from Fujitsu Software Corp. (800-545-6774, www.netprism.com), offers automation and cross-platform control, while the other, from Proactive Networks (888-638-9449, www.proactivenet.com), shares management duties with your IS staff.

Fujitsu is the first company to release Java-based network management products. Available as a free download, **NetPrism Manager** runs on Windows NT and lets you manage any SNMP device from a Java 1.1.1-capable Web browser. NetPrism Manager relies on Windows NT's security capabilities to provide access control. Although NetPrism Manager controls a maximum of ten network devices, the \$895 **NetPrism Advanced Manager** manages unlimited devices.

NetPrism Manager allows you to configure and monitor any network device through a graphical interface. Devices on the network are detected using the program's Element Managers, which enable extra control of devices beyond what's available through NetPrism's standard GUI. The Element Managers let you set rules-based, automatic management for devices, thus saving your IS staff from constantly fixing small problems.

Proactive Networks's approach is to offer combined product and service solutions that do some of the work for you while keeping you up to date and informed on the status of your network. **Pronto Check** (starting at \$5,995 for a 500-node network) is a one-time network diagnostic program. Proactive installs the Pronto Check diagnostic software on your net-

work for a four to six week period. During this time, the product gathers a "signature" of how your network operates. Pronto Check locates any "soft faults," which the company defines as network situations that are not critical at the mo-



THE WATCHERS: NetPrism Manager (left) and Pronto Watch.

Pronto Watch, your IS staff can monitor network status from any Web browser. Proactive also sends a daily e-mail report on the net-

work's performance, providing details on network utilization and potential problems.

Pronto Watch uses its Cognitive Alarm technology to locate any soft faults and immediately alerts the customer via pager or e-mail with relevant information. Proactive's 3-D Telescoping technology then helps isolate the source of the fault.—*Michael N. Rusignuolo*

ment but could lead to serious problems. At the end of the period, company consultants provide a detailed report on how your network operates and where problems might arise.

If you want constant assistance, **Pronto Watch** (\$2,500 per month for a 500-node network) offers monthly network management services. Once Proactive installs

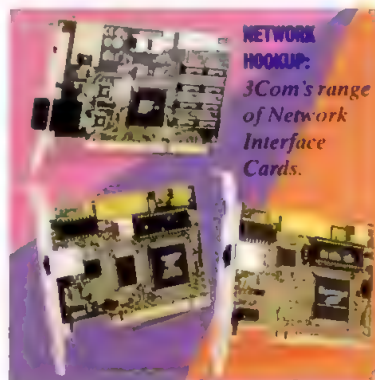
NETWORK ADAPTERS

NICs Learn New Tricks

As a product set, Network Interface Cards (NICs) typically don't inspire a lot of emotion: You plug them into your machines, and they let you connect your computer to the network. But because network downtime equals serious dollars lost, a new breed of server NICs have emerged that offer easier administration and fail-safe protection.

3Com Corp. (800-638-3266, www.3com.com) just released its Server Networking family of network interface cards. The cards offer capabilities tailored specifically to servers in their DynamicAccess software to ensure that important network connections don't go down. Self-healing drivers (SHDs) continually monitor the server link and automatically repair any net-

work problems. DynamicAccess also features Resilient Server Links (RSL). RSL ensures server access by letting stand-by NICs take over automatically if



the primary connection fails.

The Server Networking family is available across a broad gamut of protocols. The **Gigabit EtherLink**

Server NIC (\$8,050 for five units, \$1,695 for a single unit) is for those who want cutting-edge speed, and the **Token Ring-in-Fast Ethernet Server NIC** (\$249 for a single unit) provides connectivity with older networks. In addition to the DynamicAccess capabilities, the **Fast EtherLink Server NIC** (\$3,800 for 20 units, \$975 for five units, \$199 for a single unit) supports up to 16 virtual LAN (VLAN) connections, letting you grant multiple groups of users access to the same server via software without traditional routing. Intel's (800-538-3373, www.intel.com) new line of server network adapters focuses on increasing network performance through Adaptive Load Balancing and Fast EtherChannel. These technologies let administrators scale connections to prevent bottlenecks on the network by ensuring

scalable server bandwidth up to

800 Mbps. They also provide Adapter Fault Tolerance, which allows use of multiple adapters in the server or client. When you use multiple adapters, one picks up after the failure of another, eliminating costly downtime.

The **EtherExpress PRO/100+ Server Adapter** (\$119 for a single unit) provides PCI Hot-Plug capabilities that enable administrators to replace an adapter without interrupting the server. In addition, the PRO/100+ conforms to Intel's Wired for Management Baseline 1.1 specification, which claims to reduce cost of ownership by easing administration. If you're running a Web server, the **EtherExpress PRO/100 Intelligent Server Adapter** (\$399 for a single unit) is the first card on the market designed specifically for the job. It features an on-board i960 processor for low server CPU utilization. The PRO/100 Intelligent also supports VLAN connections.—*MNR*

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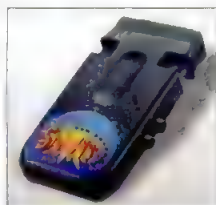
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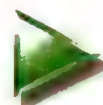
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	VisionMaster 502 (19.5" VIS)	0.27mm/dp	110khz	1800 x 1440@74hz	\$1,199
	VisionMaster 501 (19.5" VIS)	0.27mm/dp	96khz	1600 x 1200@75hz	\$1,139
19"	VisionMaster 450 (18.0" VIS)	0.26mm/dp	102khz	1600 x 1200@80hz	\$799
17"	VisionMaster Pro 17 (15.9" VIS)	0.25mm/AG	92khz	1600 x 1200@74hz	\$579
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	VisionMaster 17 (15.7" VIS)	0.26mm/dp	86khz	1600 x 1200@69hz	\$488
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First Looks



The Web's a 3-D World After All

Navigating the Web in 3-D comes of age with the arrival of new, affordable tools for creating and animating 3-D worlds.

By Linda Von Schweber and
Erick Von Schweber

As you're downloading a page into your Web browser, a distinctive banner ad appears. It's a 3-D animation; the camera quickly pans over a turquoise sea before closing in on a desert island. The camera next swoops down to a beach house as guitars dance and spin above the roof and equally large text floats in the sky, advertising the SoundBoard Guitar line.

Were this an animated GIF or QuickTime clip, the animation would just repeat ad nauseum. But it isn't a linear animation; it's a real-time interactive 3-D Web animation that puts navigation controls into users' hands.

In the example above, imagine being able to explore the island, experiencing sounds that grow

louder as you approach or text change as you act. As the designer, you'll be able to visualize 3-D controls that users can manipulate; in this case, the coconuts on the beach let users change the guitar's style and colors and rotate it to see its sides and back. These abilities add a whole new level of interactivity for users and advertisers alike.

Creating real-time animated 3-D scenes was once the province of high-end virtual-reality software that cost thousands of dollars and required specialized hardware for playback. That's changed with the arrival of a new breed of sub-\$1,000 tools.

VISIONS IN 3-D

The first products for navigating the Web in 3-D surfaced in 1995

and were based on VRML (Virtual Reality Modeling Language) 1.0. That standard specified the static aspects of 3-D scenes, while VRML 2.0 added animation and responsive behaviors. In 1997, the ISO adopted VRML 2.0 as an international standard and renamed it VRML97.

As the standard matured, Netscape integrated VRML support into Netscape Communicator 4.x, and vendors of proprietary VR and simulation tools (such as Datapath, Sense8, and Superscape) began offering VRML importing and exporting to complement their own formats. Microsoft Internet Explorer 4.0 also supports VRML as a downloadable plug-in (and VRML is integrated with that browser's CD-

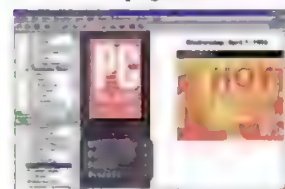
INSIDE

DYNAMIC DESIGN:

Adobe PageMill 3.0 and NetObjects Fusion 3.0 add usability and features to Web design. For the review, see pages 60 and 61.

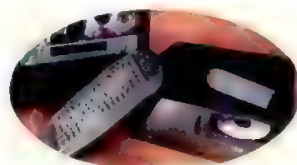
ALTERNATIVE BROWSING:

The Opera 3.2 browser can make your decision between IE and Netscape easier. See page 73.



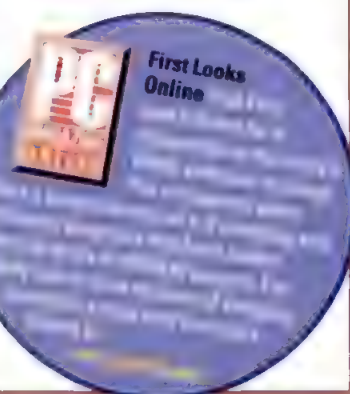
HOME DVD:

The TigerDirect PC Cinema rides the wave of TV/PC convergence. See page 76 for the story.



More Products Reviewed ...

Cobalt Cube 2700WG	56
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HP PhotoSmart C20	64
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J-Bots 2.0	73



First Looks

ROM distribution).

The little-known secret of 3-D graphics is that they're actually easier to work in than 2-D graphics. You don't need to know the peculiarities of perspective,

For browsing 3-D with OpenGL, there's Cosmo Software's Cosmo Player 2.0. (A free download for Internet Explorer and Navigator is available from www.cosmosoftware.com

library on Windows systems. If you're designing for the future, realize that Fahrenheit will look like OpenGL. But keep in mind that few mainstream end users have OpenGL capability today,

although more and more graphics board vendors are offering drivers for supporting OpenGL.

PUTTING 3-D TO THE TEST

We put four VRML97 packages and one proprietary 3-D Web product through their paces in creating our 3-D test animation, the fictitious SoundBoard banner ad. All of these programs let you create real-time 3-D worlds replete with animations and responsive behaviors.

The five products were tested in Windows 95 on two systems: a 300-MHz Pentium II machine with 64MB of RAM and Diamond Multimedia's PCI FireGL 1000 Pro graphics

card; and a 100-MHz Pentium with 32MB of memory and no graphics hardware acceleration.

One key differentiation between the packages reviewed here and traditional animation is the file output size. VRML files are relatively small, a big advantage when using this technology to create 3-D worlds. We built the most detailed of the banner ads in Cosmo Worlds and V-Realm, both of which compress the files. Cosmo Worlds' VRML file was 24K plus 32K for textures, resulting in a total download of only 56K. Since we didn't need textures in V-Realm or VRCreator, each of the VRML files output by these programs were a 35K download. At the low end, a fully functional ani-

mation without complex objects or interaction came in at 6K with RenderSoft. Compare these file sizes to that of your typical animated GIF and you'll see the appeal of developing for the Web in VRML.

Whether you're a Webmaster, a multimedia producer, or a 3-D artist, you'll find the 3-D animation packages we review in this roundup—Cosmo Worlds 2.0 (\$999 list), Platinum VRCreator 2.0 (\$120 list), RenderSoft VRML Editor 1.65 (\$15 list), 3D Webmaster 5.5 (\$999 list), and V-Realm Builder 2.1 (\$495 list)—surprisingly accessible and delightfully easy. Be forewarned that there are some inherent limitations. You may reach a point where you'll need, say, a bit of Java or JavaScript programming to accomplish such simple tasks as creating an on/off switch. Our Editors' Choice is Cosmo Worlds 2.0, from Cosmo Software. It provides an unrivaled sense of being in a virtual space and working with real objects that just happen to live inside your monitor.

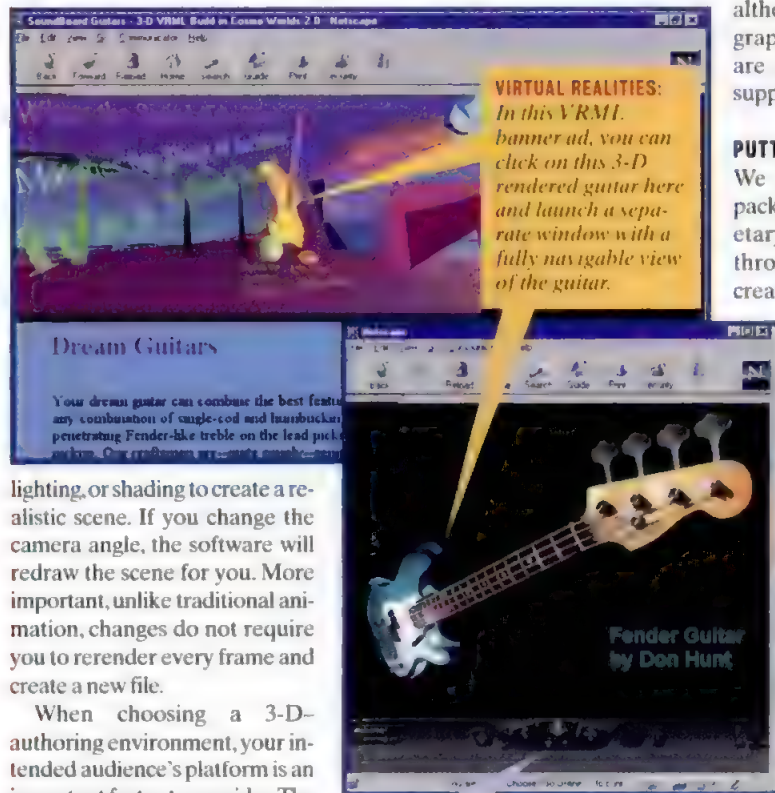
Cosmo Software Cosmo Worlds



Redefining the standard for creating real-time interactive 3-D worlds for the Web is Cosmo Worlds 2.0, from Cosmo Software

(which is in the process of spinning off from Silicon Graphics). Meriting our Editors' Choice in this roundup, Cosmo Worlds continually delighted us as feature after feature—including object manipulators called DynaControls, easy object grouping and cloning, low-polygon modeling, and great support for programmers—nearly fulfilled the ultimate wish list for this class of software.

Although Cosmo Worlds (\$999 list) doesn't satisfy every need, it goes much farther than any other tool available. Most notable is its fluid handling of



VIRTUAL REALITIES: In this VRML banner ad, you can click on this 3-D rendered guitar here and launch a separate window with a fully navigable view of the guitar.

DASHBOARD: Cosmo Player 2.0's control panel lets you rotate, pan, and zoom into the object.

lighting, or shading to create a realistic scene. If you change the camera angle, the software will redraw the scene for you. More important, unlike traditional animation, changes do not require you to rerender every frame and create a new file.

When choosing a 3-D-authoring environment, your intended audience's platform is an important factor to consider. The universe of platforms is divided, based on two 3-D-rendering libraries for Web browser plug-ins, authoring tools, and graphics hardware: OpenGL and Direct3D (D3D). OpenGL provides superior image quality and is very responsive to hardware acceleration, though many entry-level 3-D graphics chips don't accelerate it. D3D, a Microsoft DirectX technology, trades visual quality for faster software rendering and compatibility with entry-level 3-D accelerators.

A world rendered with OpenGL looks different than the same world rendered with D3D. Try to select an authoring tool that uses the same rendering library as your audience's browser plug-in, even though you'll still need to test your worlds in both OpenGL and D3D browsers.

.com; Netscape Communicator 4.05 integrates the program.) The authoring tools employ OpenGL include Cosmo Worlds, RenderSoft VRML Editor, and V-Realm Builder.

On the D3D side is Intervista's browser, WorldView 2.1. (Available on CD-ROM with IE 4.0 and as a downloadable plug-in for IE 4.0 and Communicator 4.x; visit www.intervista.com.) For authoring purposes, VRCreator uses D3D; 3D Webmaster can use D3D or its proprietary format.

These platform issues should disappear in the next two years with the arrival of Fahrenheit, a joint project of Microsoft and Silicon Graphics that will become the primary rendering li-

3-D objects and workstation-class programming support for animations and interactions.

Cosmo Worlds' dexterity is a proud reflection of the program's roots. Originally developed for the SGI platform, Cosmo Worlds is now a stable Windows application that will make you feel suddenly in control of developing interactive 3-D worlds.

Extensive documentation, including detailed tutorials and MPEG movies explaining every feature, help bring you up to speed quickly in this very rich environment. The interface and tools work much as those in 2-D graphics programs do. The property inspector is a context-sensitive panel that lets you edit such object properties as materials, textures, links, scripts, and levels of detail, all in one place.

With a single click, you can bring an object or section to the front, or hide or show only selected objects. You can also select Snap Targets, so that objects can snap to other objects' surfaces as you move them around the world. This capability is a perfect example of the simple features that make Cosmo Worlds our favorite environment. To position the guitar in our sample on the building's roof, we simply placed a Snap Target on the roof

Editors' Choice

• Cosmo Worlds 2.0



The five products in this roundup can get you started producing real-time 3-D interactive Web content, which you can integrate with your HTML pages.

Our Editors' Choice is Cosmo Software's Cosmo Worlds 2.0, a forward-looking package that makes designing in VRML easy, from the storyboard process to the finished site. Cosmo Worlds was fun to use and doesn't require a full understanding of VRML97, although a basic understanding was helpful. From the re-

sponsive manipulators for artists to an effective programmer's interface, Cosmo Worlds 2.0 should meet all of your needs.

sponsive manipulators for artists to an effective programmer's interface, Cosmo Worlds 2.0 should meet all of your needs.

We give an honorable mention to the only other program able to produce our envisioned SoundBoard site, the Microsoft Direct 3D-based V-Realm Builder 2.1, from Ligos Corp. If you know VRML97, you can make V-Realm Builder 2.1 do tricks that Cosmo Worlds' friendlier interface makes difficult or impossible. It offers the best tools for developing in D3D, which is more assessible to users today.

If you're using a Pentium-class machine without OpenGL acceleration, your only practical choice here is our other honorable mention, Platinum VRCreator 2.0. It boasts the best clip art library and has the benefit being able to render worlds so they look as they will in Intervista's WorldView 2.1.

and clicked on the guitar. While editing an object, we were able to remain in the 3-D window and use the Spacebar to switch modes temporarily and reposition the world, so we could see all sides of the object without losing context. Such manipulation tools, long taken for granted in the 2-D world, enable immense productivity gains.

Cosmo Worlds' PEP (point/edge/polygon) editor keeps files compact. The editor is also

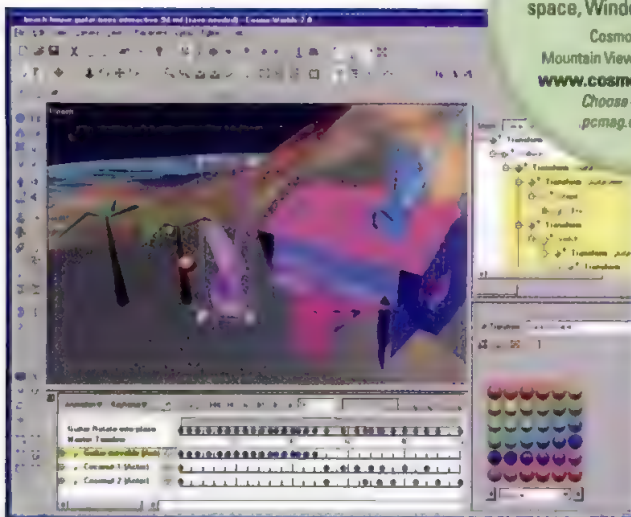
optimized for such tasks as cutting out windows, splitting polygons, rotating doors, and creating roofs. You not only can move PEPs but also extrude them, cut them into multiple objects, and even interactively position and crop textures on each polygon. The cut-rectangle tool, for example, was convenient for creating the windows and doors in our test world.

Another design boon is the PEP editor's DynaWheel. As a world's creator, you can attach a DynaWheel to a door you've selected, for instance; then you can grab the Dyna-

palm tree and become user controls, implementing squash-and-stretch for greater realism. If you've ever animated in 2-D bitmaps or even 2-D vector graphics, you'll instantly feel at home with this tool.

Setting up interactions in VRML resembles multimedia development. Cosmo Worlds has made the "wiring" of routes—which send an object's output (such as its rotation) to another object—quite visual and easy to implement. The program provides the best programming support that we encountered in this roundup; we found it simple to write basic JavaScript programs, such as the one we used to create a control for changing the instrument displayed on-screen.

The Extras menu includes VRML97 nodes that you can create and edit in the outline editor, but not in the GUI interface of the property inspector or the view window. Nodes that you can't easily edit are for sound, text, backgrounds, fog, collision, extrusion, indexed line sets, elevation grids, point sets, sensors, interpolators, and light attenuation. For instance, we created a background node but couldn't select a color from a color wheel; rather, we had to enter the RGB values manually. We created a terrain from a PEP object that



KEY TO SUCCESS: Cosmo Worlds' top-notch keyframe editor allows you to animate anything that you can edit.

Cosmo Worlds 2.0

List price: \$999

Requires: 32MB RAM (64MB recommended), 35MB hard disk space, Windows 95 or NT 4.0

Cosmo Software,
Mountain View, CA; 888-912-6706
www.cosmosoftware.com
Choose 409 at www.pcmag.com/infoLink.

First Looks

we broke into smaller faces and edited by moving vertices up and down, but the object we created was three times the size of a proper elevation grid.

Since we couldn't apply color per vertex in Cosmo Worlds, we couldn't produce beautiful color gradations on our mountains, as we did in V-Realm. Instead we used texture maps on our ocean and cliffs. As a result, we could get neither the visual effect nor the speed that we wanted for the world.

We were impressed when Cosmo Worlds compressed the final file, containing all of our animations and interactivity, to just 24K. The texture files added 32K, for a total download of 56K.

The artist, the animator, and the developer will all be comfortable working in Cosmo Worlds' environment. On our Pentium II test system, excellent performance and Cosmo Worlds' great controls created a sense of fluidity, and building worlds became an enticing and compelling prospect.

Cosmo Worlds 2.0 defines a new relationship between the artist or programmer and 3-D applications on the PC. The interface is powerful and fluid. Although there are a few shortcomings, plug-ins will likely crop up to fill in the missing pieces. Our selection for this roundup's Editors' Choice, Cosmo Worlds will change your approach to graphics.

Platinum technology inc.

Platinum VRCreator

Platinum VRCreator 2.0 is aiming to be the Microsoft PowerPoint of VRML. Toward that end, it offers a visual interface and a drag-and-drop library packed with 3-D clip models that can provide the building blocks for a 3-D world.

VRCreator 2.0 Personal Edition is actually the full-fledged version of VRCreator Learning Edition (which is often bundled with other programs and is

downloadable for free). The latter product limits the complexity of the worlds you can create. At \$129 the Personal Edition includes more clip art and a throwaway modeler.

With the largest selection of 3-D clip models of any program in this roundup, VRCreator's library has a wide variety of objects, including buildings, furniture, and cityscapes. You can preview the models from within the library, spinning them around to see all sides. Unfortunately, objects are not all built to the same scale, so a refrigerator you drag into a building could conceivably end up sticking out through the roof. But fortunately, since VRML is resolution-in-

lets. You can attach objects together and snap them to the grid, so they're easy to place.

VRCreator makes some kinds of interaction much easier to design than in the other packages. For example, you can drag and drop prebuilt behaviors such as "Click and I Explode" onto objects. If the provided behaviors and objects meet your needs, then you can do much without being a programmer or an artist.

If you're creating your own animations though, you may find that the limitations of VRCreator are too

line documentation, which covers the program's features and provides an introduction to 3-D and VRML. Be sure to get the latest edition, as Platinum posts fixes and additions frequently.

GZIP compression is built into VRCreator, as it is in V-Realm and in Cosmo Worlds. The final VRCreator file, which included most of the interaction in our script, compressed to 35KB and did not need textures, so 35KB is the entire download size.

VRCreator's interface is great for creating simple, fun worlds, and it provides what you need to evaluate VRML's value to your Web site. If

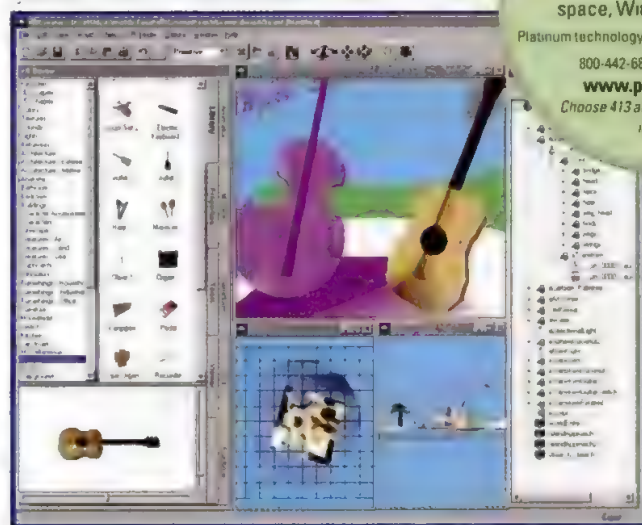
you're just getting started in VRML and have a slow machine without 3-D acceleration (or with only D3D acceleration), VRCreator is the tool for you. But if you're implementing highly customized interactive worlds, you may quickly need to graduate to one of the roundup's other, more professional-level tools.

RenderSoft Software and Web Publishing

RenderSoft VRML Editor

This roundup's greatest surprise is RenderSoft VRML Editor 1.65, a lean yet capable tool for exploring VRML97 keyframe animation. As a free download or a purchase with a registered cost of just \$15, and with a footprint of under 2MB, this product is a study in minimalism that works extremely well.

RenderSoft manages this by including only a subset of VRML97 capabilities; it's only capable of reading VRML 1.0 files and exporting VRML 2.0 files. This constrains the user to



3-D LIBRARY: VRCreator's ample library of 3-D objects provides thumbnail views, a preview window, and details about the objects.

dependent, you can easily resize the refrigerator.

Although VRCreator provides tools for creating a basic guitar, we couldn't create enough realism to show differences between the actual guitars. In addition, VRCreator can't optimize worlds, since it lacks instancing and in-lining.

But VRCreator's ability to edit groups, members of groups (primitives), and vertices (points) let us create our beach by pulling vertices up to become the tops of sand dunes and below water level to become in-

great, even though there's support for such advanced VRML97 features as routing and scripting. We couldn't create a keyframe animation that moved multiple objects at a time, for example, to have the guitar jump and spin down to the beach, followed by the coconuts falling from the palm tree. We had to create additional separate animations for each coconut and trigger them when the user approached via a proximity sensor.

One of VRCreator's strengths is its extensive printed and on-



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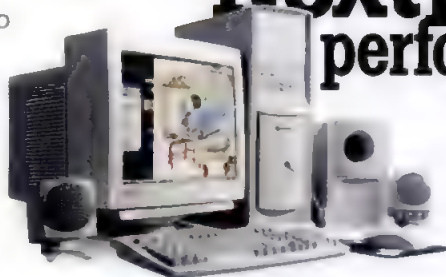
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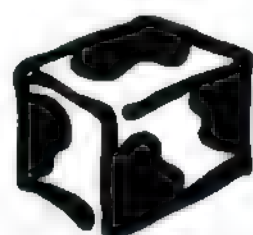
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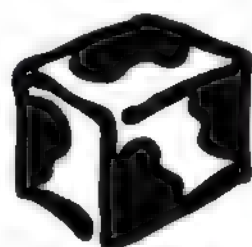
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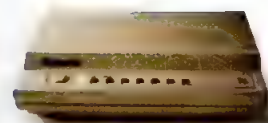


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First Looks

the very simple but efficient polygon-extrusion editor and primitive objects for creating a scene.

Short of Cosmo Worlds, RenderSoft animates the most VRML properties of any product reviewed here, so it's a great tool for producing small but active worlds. It's also the only sub-\$495 OpenGL-based authoring tool we found.

RenderSoft's interface provides a single toolbar with icons for creating, positioning, coloring, and texturing primitive shapes and lights. Note that since RenderSoft doesn't place a bounding box around a selected object, it's sometimes tricky to control the size, precise placement, and rotation of objects.

We created all objects with the software's limited but easy-to-use modeling tools. Using the extrusion editor, we produced an interesting though flat shape for our beach and palm fronds and an irregular box for our building. We couldn't cut doors or windows into the box or even edit our palm fronds after we made them.

The keyframe animator proved simple to use. The tool opens on the entire scene, and you can animate any object by simply changing it and clicking the record button on the animation panel. We animated object positions, rotations, and scale; materials' color, shininess, and transparency; textures and viewpoint (camera) position; and light positions and colors.

Given RenderSoft's inherent limitations, we scaled back the testing script, settling for a single background color and a single looping animation instead of the more complex worlds we created with the other packages. We couldn't create a button or sensor to trigger an animation or control the HTML frames from the VRML world.

The world we built had an animated banner ad that flew into the SoundBoard beach scene, lingered so the user could click on the guitar to go to SoundBoard's Web site, and then

pulled back, just to loop again and again. The entire file size: a mere 6K.

To explore the potential of VRML and keyframe animations in 3-D, download RenderSoft and play. You can't do everything, but you can produce a simple storyboard animation to sell your boss or client on the value of real-time 3-D anima-

tiveX control for Microsoft IE Version 3.0 and higher, and a plug-in for Netscape Navigator Version 3.0 and higher. Authoring SVR files didn't fare much better than working with VRML. Limited to 256 colors, 3D Webmaster feels like a multimedia authoring program circa 1993.

The included modeler is also

and interactivity—we didn't feel we got much bang for the byte with 3D Webmaster.

3D Webmaster's strength is its simulation-oriented control of object dynamics and interaction, with support for gravity, friction, bouncing, and even collision detection and reaction—a feature that requires heroic programming efforts within VRML97. But these features are frame-based, not time-based; as a result, animation speed varies with the speed of the playback platform, an unacceptable situation for games and simulations. Users with specialized needs and a controlled viewing platform would be better off with a high-end VR or simulation tool from Multigen, Prosolvia Clarus, or Sense8.

3D Webmaster's output in Viscage, its proprietary browser, can render faster than VRML. But that's only because 3D Webmaster's objects tend to lack backs or insides, they generally use only

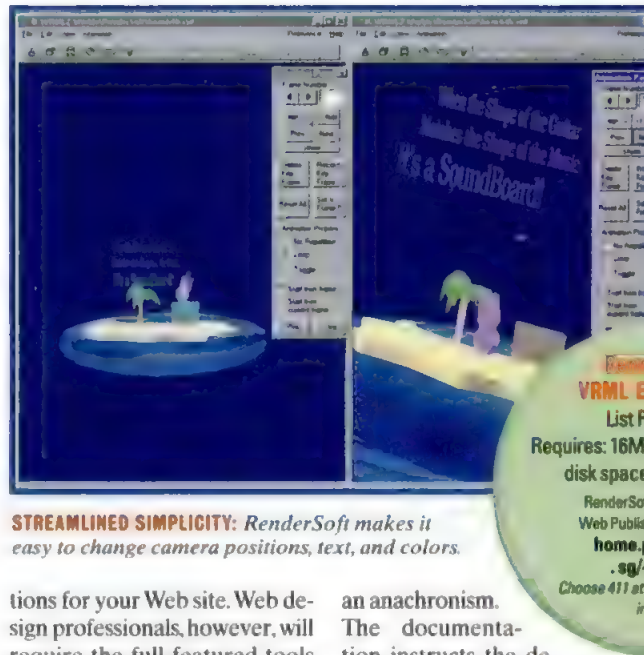
256 colors, and the program doesn't generally render lighting in real time for the entire scene. The result is worlds that look flat, because shading and lighting don't change as you move about.

If you need to build to the 486 platforms of the past, 3D Webmaster is the only tool you should consider. For Pentium-class machines, you'll be much better off in VRCreator. On the higher end, since Cosmo Worlds offers a far friendlier and more capable standards-based contemporary environment for less money, we'd be hard-pressed to recommend 3D Webmaster.

Ligos Technology

V-Realm Builder

From Ligos Technology, a subsidiary of Integrated Data Systems, comes V-Realm Builder



STREAMLINED SIMPLICITY: RenderSoft makes it easy to change camera positions, text, and colors.

tions for your Web site. Web design professionals, however, will require the full-featured tools found in this roundup.

Superscape Inc.

3D Webmaster

The roundup's only product based on a proprietary format, Superscape's 3D Webmaster 5.5 (\$999 list) is a puzzlement. It's a poor choice for authoring VRML worlds, and it only partially addresses the specialized needs of developers who might consider proprietary solutions.

Though marketed as a VRML 2.0 authoring package, 3D Webmaster's VRML97 export doesn't support animation and interaction. During testing, only geometries—material properties such as color, viewpoint, and light—could be exported or imported from VRML97.

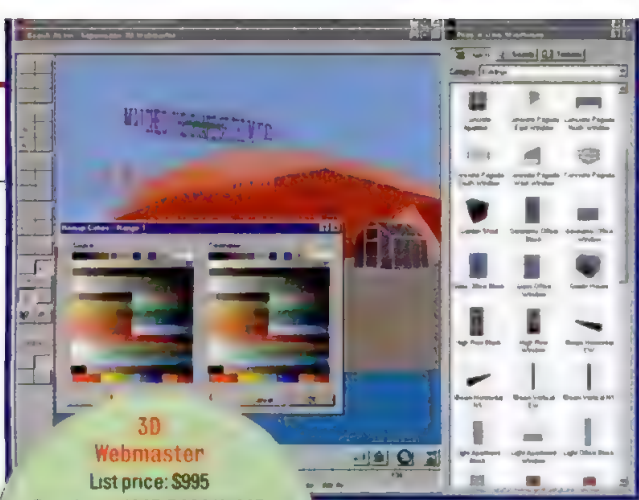
You view the proprietary SVR files with Viscage, an Ac-

anachronism.

The documentation instructs the developer employing transparency with Z-buffering to set the order in which polygons draw and eliminate overlapping objects manually—a tedious job at best.

With an unfriendly modeler and VRML 2.0 import crippled, developers will be highly reliant on the drag-and-drop warehouse of 3-D clip art. Unfortunately, the text the from warehouse caused error messages in Viscage. If you will not be using the shape and sound editors in 3D Webmaster, Do 3D, Superscape's entry-level product may be a better choice.

Our SVR file was 67K without guitars, textures, and animation, and you cannot compress files. Since our richest VRML worlds came in under 40K—including our sculpted guitars, 3-D mountains, multiple animations,



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Webmaster

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REMAPPING COLORS: 3D Webmaster requires several steps to change an object's color.

you like and automatically blended. Such skies and terrains make V-Realm's worlds beautiful and efficient. They render just as beautifully in Cosmo Player 2.0, because both that product and V-Realm use OpenGL, but they look very different in Intervista's WorldView. Based on D3D, WorldView uses a single color for each face rather than rendering the gradations; this makes its world faceted, not smooth.

V-Realm Builder's interface tries to guide you through the process of creating a world, using context-sensitive indicators. For instance, it grays out icons that aren't appropriate for your position in the tree view of the VRML scene graph. But although these subtle aids are helpful, the user with a good understanding of VRML97

will appreciate them most. The documentation is slim and refers readers mostly to VRML97; if you need help, you'll have to look for it in sources outside V-Realm's offerings. Try *VRML 2.0 Sourcebook* (John Wiley & Sons) or *Teach Yourself VRML 2 in 21 days* (Sams.net Publishing) for information specific to V-Realm optimizing worlds.

Creating a world requires more planning with V-Realm Builder than with the other products we saw. Although you can drag and drop a few objects into a scene, we were quickly forced to deal with the tree view and its many nodes. For instance, to create objects that would move together, we couldn't simply select two objects and click on an icon to create a group as we could in Cosmo Worlds. We first had to insert a transform node into the tree view (and know that we needed to do this); then we had to cut and paste the individual objects into the transform node's children node.

Detail in V-Realm suffered,

too. Our beach house was a simple box, and we cut out the doors and windows with V-Realm's very limited indexed face-set editor; our Cosmo Worlds beach house was more interesting, because that program's PEP editor lets you create very efficient, detailed objects.

If you have a programmer's mind and enjoy tinkering with and optimizing code, V-Realm Builder will let you produce beautiful, efficient, fully interactive worlds quickly and easily. V-Realm Builder ships with some great snippets of code, including an animated wave, which we used for the water surrounding our island. We created a wavelike sculpture and turned it into a "start the wave" control with a touch sensor, which was processed through a short JavaScript program. That program created a toggle switch that turned the wave on and off when the user touched the controls.

V-Realm's performance on our tests was excellent. In fact, Cosmo Worlds and V-Realm Builder are the only programs in this roundup that let us complete our test script for building interactive, real-time 3-D worlds for the Web.

The final V-Realm file—containing three extra instruments, the wave, and all animations and interactions—came in at only 35K and didn't need any textures. This result underscores the efficiency of the VRML97 format. We couldn't have placed a still-image banner ad on the page in 35K, much less an animated GIF or MPEG file.

V-Realm Builder 2.1 is a valuable asset for any professional studio creating VRML97 3-D worlds. With its support for color per vertex and its efficient technique for creating gradation in objects and interactively creating backgrounds, it fills the two gaping holes in Cosmo Worlds' feature set. If you're serious about producing 3-D content for the Web, you'll need at least one, if not both, of these programs. **PC**

2.1 (\$495 list)—a visual programming tool with a few choice artist's brushes. Because of V-Realm Builder's full VRML 1.0 support and ability to produce tight VRML code, Version 1.0 was our Editors' Choice nearly two years ago ("The Web Goes 3-D," November 5, 1996).

The program's interface is largely unchanged, but the package supports all of VRML97's new capabilities, including keyframe animation, interaction, and routes and scripts. It also offers limited but usable editors for elevation grids, indexed face sets, and extrusion. V-Realm Builder 2.1 belongs in any 3-D Web professional's toolbox. In the hands of a programmer, it provides a good standalone development environment; for the rest of us, it's a perfect complement to Cosmo Worlds.

Several of V-Realm's editors are unique in this roundup. Most notable are facilities for applying color per vertex to objects and terrains. Color per vertex is the difference between V-Realm's beautiful gradations in the beach and water scene, and the single color per polygon and textured polygon approaches of VRCreator and Cosmo Worlds, respectively.

Another outstanding feature is the background editor, which lets you set four ground colors and four sky colors, angled as

V-Realm
Builder 2.1

List price: \$495

Requires: 16MB RAM, 30MB hard disk space, Windows 95 or NT

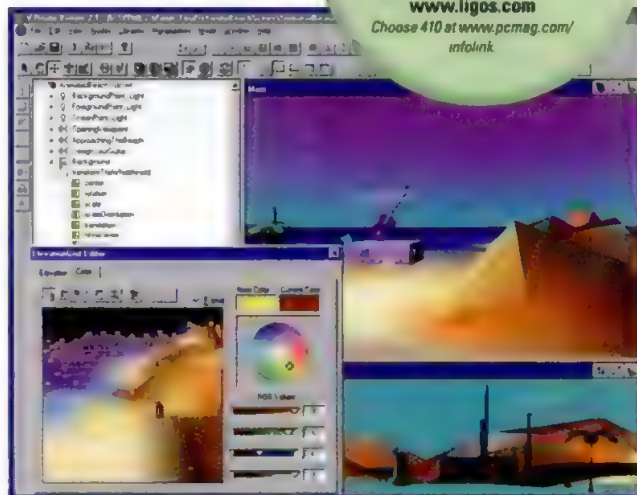
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COLORS OF THE RAINBOW: V-Realm Builder facile handling of colors enables you to edit backgrounds and create gradations on objects.

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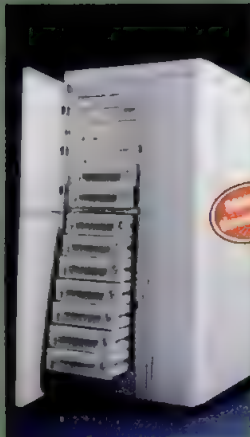
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First Looks

MICROSERVERS

Server with a Smile

The Qube supplies everything a small workgroup needs to communicate, collaborate, and build a Web presence.

By Greg Alwang

The concept of micro-servers—servers designed to provide simple, complete Internet and intranet services to nontechnical users—has been around for a while, but we're just beginning to see some truly viable and affordable solutions. Cobalt Microserver's Qube 2700WG (\$1,249 list, tested configuration) comes preconfigured with Web and FTP services as well as e-mail, threaded-discussion, file-sharing, document-management, and search capabilities. The Qube is an ideal plug-and-play intranet solution.

Housed in an 8-inch cube weighing less than 6.5 pounds, the Qube consists of a 150-MHz RISC processor, 16MB of DRAM, a 2.1GB Ultra ATA hard disk, a 10Base-T network interface, and a two-line LCD console. (A 32-MB model with a 6.4GB hard disk is also available.) All configuration and maintenance is done through the LCD console and a Web browser, so you don't need a monitor or keyboard for the unit.

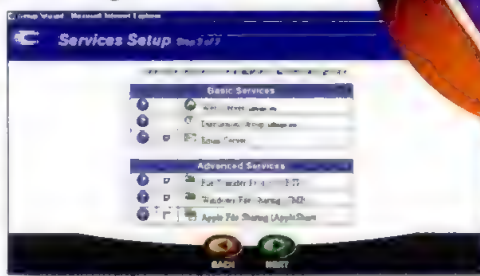
SETUP IS A SNAP

Unlike a general-purpose Unix or Windows NT server, the Qube doesn't require an experienced administrator to load and configure the OS and Web server software and then contend with the intricacies of setting up and maintaining e-mail and collaboration software. On the contrary, the Qube comes pre-installed with Apache 1.2 and Linux 2.0.

We unpacked the Qube, configured the server, added five users, and accessed the collaboration applications in less than 30

minutes. All we had to enter was the IP address of the Qube using the LCD console, then the rest of the configuration was completed from a browser.

The setup wizard guided us as we entered the domain name and DNS information, the services we wanted to run on the Qube, and the names of the users and group members. The integrated DNS service lets in-



HIDDEN POWERS: You'll never know Apache is under the hood, thanks to the setup wizard.

tranet users access the Qube using its domain name rather than its IP address. All this adds up to an extremely gratifying out-of-box experience.

UP AND RUNNING

Each user added to the system is allocated a specified amount of disk storage, an e-mail address, and a personal home page that can be modified using Cobalt's interactive PageBuilder tool or an HTML editor. When you access the Qube, you're met with a custom Web-based front end with links to users, groups, searches, personal profile, and document management pages.

From the user and group pages, you can send mail, visit home pages, and join threaded discussions. The personal profile page lets you change account

settings and back up your home directory to a local disk.

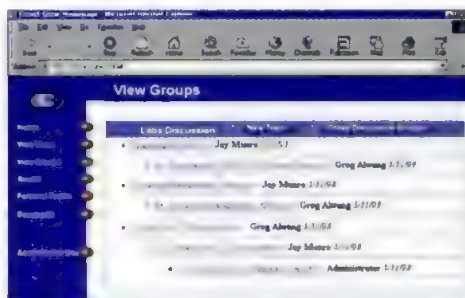
The integrated e-mail service simultaneously supports the IMAP4, POP3, and SMTP protocols and lets users forward mail to another address or use an auto-responder if they're out of the office. In addition to FTP, the Qube supports the Windows



Server Message Block (SMB) and Appleshare protocols. This lets Windows 95 or Macintosh clients see the Qube as another storage resource on

the network, making it simple to drag-and-drop files to and from shared directories on the workgroup server. You can't get more user-friendly than this.

Each group created on the Qube gets a customizable home page, a private threaded discus-



DISCUSS: Each group on the Qube gets a private threaded discussion database, a home page, and a private document management infobase.

sion database, and a private document management infobase. The integrated InfoPlace Document Organizer provides an easy way for users to organize and

search for documents on the Qube. In addition to documents stored in the infobase, the Web server automatically indexes all text and HTML documents, facilitating quick searches.

The Qube is ideal for small workgroups that need to disseminate Web-based information or for small businesses looking to bring Web hosting in-house. ISPs in need of single-client hosting options will also find the Qube very cost-effective solution. For developers, the product supports both CGI and Perl scripting and can be used to deliver a complete turnkey Web application solution. A developer version of the Qube (without collaboration and document management features) will be available for \$999 (list) by the time you read this.

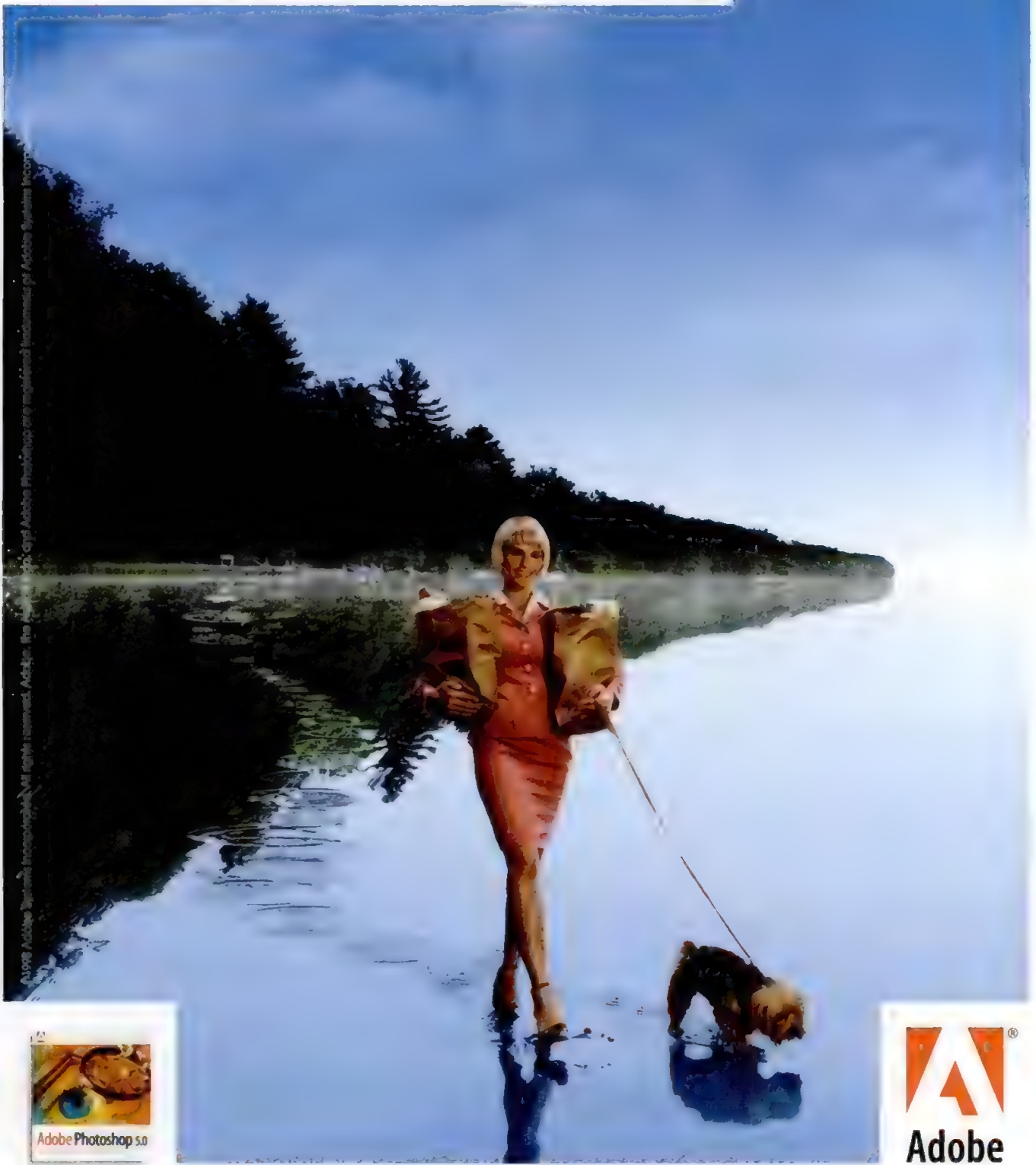
Administration and regular maintenance are a breeze, thanks to agents that run in the background and monitor server usage and network collisions. If a monitor encounters any problems, an e-mail alert is sent to the administrator. These agents also maintain logs of HTML and CGI requests and track the average number of hits per day and hour.

The Cobalt Qube doesn't have the flexibility or expandability of a Web server based on Netscape Enterprise or Microsoft Internet Information Server. But the Qube does offer an extremely low-maintenance, low-cost solution that will appeal to small offices and workgroups lacking the capital budget or IT expertise to deploy a traditional Web server and collaboration combo.

Cobalt Qube 2700WG. List price: \$1,249 with 150-MHz RISC CPU, 16MB RAM, 2.1GB

hard disk. Cobalt Microserver Inc., Mountain View, CA; 650-930-2500; 888-702-6225; www.cobaltmicro.com. Choose 408 at www.pcmag.com/infolink.

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First Looks

WEB AUTHORIZING TOOLS

Wake Up Your Web Site

Brand-new versions of Fusion and PageMill court both novice and professional Web designers.

By Edward Mendelson

The third generation of WYSIWYG Web site editors has arrived. NetObjects Fusion 3.0 (\$295 list; \$99 upgrade) and Adobe PageMill 3.0 (\$100 street; \$49 upgrade) both create elegant Web pages and manage complete Web sites, but in strikingly different ways. NetObjects Fusion is a high-end automated package bristling with up-to-date features like Dynamic HTML (DHTML) and is even more ambitious and more highly automated than our Editors' Choice-winning Microsoft FrontPage 98 ("Web Authoring Tools," January 20, 1998). PageMill is a midlevel package best suited for building relatively simple Web sites at top speed. Either package lets you create and upload a Web site with a minimum of technical knowledge and a maximum of ease.

NETOBJECTS FUSION 3.0

A giant factory for constructing Web sites, NetObjects Fusion 3.0 makes every other HTML editor seem like a small-scale artist's studio by comparison. The package automatically applies well-designed, customizable graphics styles to an entire Web site, builds navigation bars, applies DHTML formatting for rollover and animation effects, arranges text and image elements with single-pixel precision, and uploads your site to a remote server. Everything in the program, including a message board and a small-scale database suitable for product descriptions or an employee directory, can be built without any

knowledge of HTML, although learning the program becomes more difficult when you move beyond its basic features.

Fusion's earlier versions appealed mostly to designers who liked its ability to produce graphics-rich Web sites and didn't object to the bloated and mostly unreadable HTML code the program generated. This new version retains the precise design tools of earlier versions and enhances control over the size of frames and borders. Version 3.0 also adds new options for generating lean, readable HTML code. If your target audience uses Version 4.0 browsers, you can set Fusion to output HTML with stylesheet

and JavaScript features for maximum elegance with minimal file sizes.

WHAT YOU'LL SEE

Fusion's interface uses five separate views: a tree-style site diagram; a page editor; a stylesheet gallery; a list of files, applets, variables, and other assets included in a site; and a control panel for publishing sites to a

folder on your hard disk or a remote Web site. Basic features are easy to use: You can import graphics and other files merely by dragging them into the program window, letting the program copy them transparently to the right folder on disk, and uploading them to a remote site.

In a misguided effort to make

ity to convert text into graphics. You can use any font installed on your system and rotate a line of type to any angle. Unlike FrontPage or PageMill, Fusion won't automatically convert imported graphics into GIF or JPEG formats.

Also unlike FrontPage or PageMill, Fusion won't let you edit more than one page at a time, nor does it have a window for directly editing the HTML code generated by the program. This new version, however, lets you view but not change the HTML code it generates. A

new feature lets you insert your own custom HTML code in addition to Fusion-generated code.

Another new feature lets you draw a box that displays the content of any existing HTML page on your disk, but the contents of these external pages appear only when you publish your site to your server or preview it in a browser. In Fusion's editing screen, the external page appears only as an icon, and if you want to view or edit its contents, you click on the icon and edit the contents in a code-based HTML editor. (Allaire's HomeSite 3.0 is included in the package).

unique is by trial and error or by close study of the 500-page manual.

All other major WYSIWYG Web editors resemble word processors that let you enter text by typing directly on the page. Fusion, by contrast, resembles a desktop publishing

package in which everything on a page is surrounded by a visible or invisible box. You must first draw a text box before you can type even a headline. But Fusion compensates for this kind of inconvenience by offering powerful graphic features, such as the abil-

ADDING DYNAMIC HTML

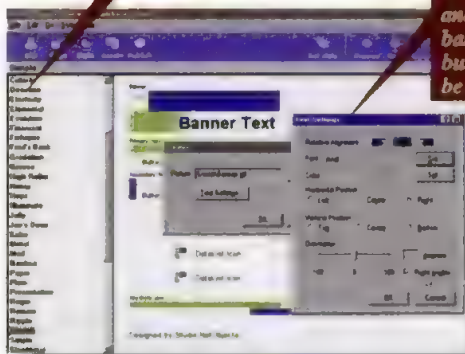
Fusion's new JavaScript-based DHTML features work by default in both Internet Explorer 4.0 and Netscape Communicator 4.0, but you can reduce the size of the code by targeting only one browser. You can build these features only by navigating a complex tree diagram of the page structure. You will probably have to call NetObject's helpful technical support before you figure out that some effects—such as opening a second browser window—must be linked to the top level of

Fusion's Dynamic actions are applied from fly-out menus.

The Master Border can appear in the browser as a separate frame or as a region of the page.

Fusion ships with about 50 graphics styles.

Built-in styles can be modified, and text in banners and buttons can be rotated.



NetObjects Fusion 3.0. List price: \$295; upgrade, \$99. Requires: 32MB RAM, 50MB hard disk space, Microsoft Windows 95 or

now live in the editing window, and the interface is less clumsy than in previous versions. Dozens of conveniences have been added—such as a feature that automatically remembers where you left the cursor when you closed a file. But awkward patches remain, and no tools are provided for building up-to-date Web features like cascading stylesheets, scripting, or DHTML.

Users can drag multimedia

Street price: \$100; upgrade, \$49. Requires: 16MB RAM, 20MB hard disk space, Windows 95 or NT 4.0. Adobe Systems Inc., San Jose, CA, 800-411-8657, 408-536-6000; www.adobe.com. Choose 406 at www.pcmag.com/infolink.



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First Looks

UTILITIES

Use Your Brain

Natrifical's The Brain offers a more natural way to organize your files.

By Troy Dreier

Do you need a brain? Natrifical thinks you do. The Brain (\$49.95 list) promises to change the way you store files and notes on your computer. With a futuristic graphical interface, it's the perfect solution to a problem that may not really exist.

The Brain stores files associatively rather than hierarchically. This means you can link any file to any other file. Besides storing standard documents, The Brain can link to Web sites, sounds, and some types of e-mail. You can link your client notes, for example, to the client's Web site and its budget spreadsheet. In linking by association, The Brain mimics

the way people remember things.

To use the product, you'll have to learn a new lexicon. For instance, an *active thought* is whatever note or document is currently at the center of your *plex*, or work area. Click on a document and The Brain rearranges itself so that this new thought is at the center. A link above your current thought is a parent link, while links below are children. Links to either side are jump thoughts.

The software is supposed to be as natural to use as its name-

JUST THINK:
The plex (the black area) shows where your thoughts, or files, are stored and how they relate to one another.

sake, but it's awkward at first. There's no way to see all of your files at once, and you have to get used to naming a document before you create it. For example, you might create a thought called *client notes*, then click on it to create a document with that name. You can drag preexisting files directly into the plex area, but don't try to use The Brain to mimic your existing file structure. If any one thought has too many child thoughts, the file names sit on top of one another and become unreadable.

The Brain is so beautifully de-

signed that we enjoyed simply watching it rearrange itself. If you forget where you've stored a file, hit Wander and watch your files move across the screen, then stop when you find the right one. You can also search for files by keyword. The Brain can search the Web just as easily, using a variety of search engines.

The Brain's biggest problem is that file storage isn't all that difficult in the first place. But if you find that putting files in folders is simply too linear and you're always forgetting where you've stored things, perhaps The Brain is for you.

The Brain 1.02. List price: \$49.95. Requires: 16MB RAM, 2MB hard disk space, Microsoft Windows 95, 98, or NT 4.0. Natrifical Software Technologies, Santa Monica, CA; 800-652-7529, 310-656-8494; www.thebrain.com. Choose 400 at www.pcmag.com/infolink.

DIGITAL CAMERAS

Consumer Megapixel

HP's PhotoSmart C20 high-end consumer camera matches megapixel images with usability features.

By Bruce Brown

Hewlett-Packard's continued focus on the home market with its new PhotoSmart C20 megapixel digital camera (\$700 street) bodes well for consumers. A great second-generation camera, the C20 has a compact design, megapixel image quality, and easy-to-use photo-finishing software. Although it lacks zoom capability, the C20 is a good bet for family users and general business applications.

The three-quarter-pound camera (with batteries) has a maximum 1,152-by-872 resolution, yielding a total of 1,004,544 pixels. Normal, fine, and super-fine modes let you save 40, 20, and 8 pictures, respectively, in JPEG format on the included 4MB CompactFlash card. The camera has an ISO equivalency of 100, a glass lens with apertures

of f/2.8, f/5.6, and f/11, and a shutter speed that ranges from 1/500 of a second to 4 seconds. Exposure can be automatic or set manually.

The C20 bundles all you need for convenient image capture, including batteries, an AC adapter, a PC connection serial cable, and a 16.4-foot NTSC video cable for displaying captured images on a TV. Three flash modes, image resolution, and self-timing are selected via a monochrome LCD that also shows the remaining image capacity and battery level. The original set of four double-A batteries was going strong after capturing more than 50 test images (all downloading to the PC was done under AC power).

You can use the C20's 1.8-inch



color LCD for framing pictures, though that's a quick way to burn battery life. Instead, use the color LCD to review stored images and to control image exposure, screen brightness, picture locking, nine-image viewing mode, slide show, and memory card formatting.

Photo Finishing software makes it easy to select, enhance, save, and print photos. Also included is Microsoft's Picture It!

2.0, with even more options and controls.

Images taken in the highest resolution mode had impressive detail and color, comparing well with traditional scanned photographs and exceeding the photo-printing ability of most ink-jet printers.

Used with the HP PhotoSmart Printer and high-quality photo paper, it was

still easy to tell the difference between conventional and PC-printed shots. But convenience and lower cost per exposure make the C20 a great choice for families that take lots of pictures. **HP PhotoSmart C20.** Street price: \$700. Requires: 16MB RAM, 110MB hard disk space, Microsoft Windows 95. Hewlett-Packard Co., Palo Alto, CA. 888-474-3867; www.hp.com/go/photosmart. Choose 402 at www.pcmag.com/infolink.

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First Looks

ACCOUNTING SOFTWARE

A Better Bottom Line

Peachtree 2000 offers sophisticated accounting features that fit your budget.

By Thomas White

Peachtree Software, a perennial leader in the under-\$300 accounting software market, is now targeting larger companies with its release of Peachtree 2000 for Windows. Looking to address the needs of businesses that have outgrown Peachtree Complete and its competitors, Peachtree purchased MICA Accounting Software in January. Peachtree added a Fixed Assets module, made a few enhancements to the user interface, and reduced the price from over \$8,000 to \$2,000 (street).

Key reasons companies outgrow their accounting packages are lack of features, limited security and multiuser support. Peachtree 2000 can support up to 25 users; it's packed with accounting features and is particularly well suited for distributors and job-oriented contractors. Security provisions include four levels of access to each menu choice, enabling the most control-minded accountant to deploy this software company-wide.

Peachtree 2000's Windows interface isn't as polished as that of other Peachtree products, but all functions can be performed without a mouse so as not to impede heads-down data entry. Look for future versions to include improved navigation and more drill-down inquiries.

HIGH-END FEATURES

The general ledger chart of accounts can be divided into four segments in order to support divisional and departmental reporting. Since the first segment

can be a company designator, you can maintain the books for the parent company and multiple subsidiaries within one logical Peachtree 2000 company. This multicompartment capability is nearly unheard of in a package at this price.

The sales order module also includes many features found in more expensive packages, including the ability to ship from different warehouses on a single sales order and produce quotations, blanket and drop-ship orders. Peachtree 2000 maintains the shipping costs for Federal Express and UPS, so freight costs

can be automatically calculated.

Clicking on the Financial Snapshot icon displays key financial indicators such as sales, purchases, returns, inventory value, margin, and bank balance. This could be improved by allowing users to drill down on the figures to view further detail.

Using commission tables, sales managers can designate commissions based on sales, profits, or margin. They can also track whether commissions are earned when the sale is booked or paid

The Financial Snapshot screen displays a grid of financial data. It includes sections for Accounts Receivable, Accounts Payable, Sales Order Processing, Purchase Order Processing, Inventory Control, and Miscellaneous. Each section contains a table with columns for Sales, Returns, and Totals. The data is presented in a clear, organized manner, allowing users to quickly review key financial indicators.

SNAP! The Financial Snapshot displays various key business indicators and provides management with a real-time performance gauge.

and whether tiered commissions are applied on a graduated or total amount basis. Peachtree 2000 includes a routine that lets you post commissions to payroll or simply print the reports and enter the commissions manually.

REPORTING THE RESULTS

Most businesses find sales reports critical in the decision-making process. Peachtree 2000 offers several key reports, including sales by territory or by customer; it can also analyze trends.

PEACHTREE 2000's stock item screen maintains the key attributes of your finished goods or components. Click on the button to identify approved suppliers.

Almost all of Peachtree 2000 reports let you choose numerous selection criteria so you can filter and sort the data as needed.

If you don't like the host of standard financial reports offered, Peachtree 2000's financial report writer can format balance sheets, income statements, and cash-flow reports. If you are looking for a graphical WYSIWYG tool, however, you will need to purchase IQ Report Writer for \$500 (street).

If you sell serialized or lot-controlled items, Peachtree 2000 can track the individual

parts from purchase through sales. Three units of measure—purchase, stocking, and selling—are maintained; this lets you buy in pallets, stock in cases, and sell in six-packs. Items can be costed on a weighted average, LIFO, FIFO, or specific item basis.

For companies that assemble component parts into finished goods, the Bill of Material tracks the number of components required in a finished good and relieves inventory as necessary upon completion of the assembly. You can maintain a list of vendors for each part, designate a rank for each, and even track the vendor's own ID for that part. The software automatically tracks the last cost from the vendor, the average delivery days, and the year-to-date purchases.

Job-oriented businesses, such as construction, will appreciate the features of the job-cost module. Integration with purchasing and inventory means that equipment or subcontract labor can be purchased directly to a job.

The software also integrates with payroll for in-house labor costing, accounts payable for direct

costs, accounts receivable for customer billing, and general ledger for financial reporting. The software can help manage the percentage complete and the profitability of each job.

If your small businesses has outgrown its accounting software, you'll want to check out Peachtree 2000.

Peachtree 2000 for Windows. Street price: single user, \$2,000; 4 users, \$2,500. Requires: 8MB RAM, 60MB hard disk space, Microsoft Windows 3.x, 95, or NT. Peachtree Software Inc., Norcross, GA; 800-228-0068, 770-724-4000; www.peachtree.com. Choose 404 at www.pcmag.com/infolink.

The Stock Item screen displays detailed information for a selected stock item. It includes fields for Stock ID, Description, Product Code, and various inventory levels. The screen also shows a list of locations and vendors, along with their respective quantities and costs. The data is presented in a clear, organized manner, allowing users to quickly review and manage their stock items.

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¹⁾K56flex™ technology products are capable of 46kbps. Due to FCC rules that restrict power output, however, current download speeds are limited to 54kbps (max). Upload speeds are limited to 45 kbps. Actual speeds may vary depending on line conditions. ²⁾Data on a CD-ROM is read at a variable transfer rate, ranging from 10k at the innermost track to 24X at the outermost track (the data transfer standard 1X rate equals 150 kb/bytes/second and the average data transfer rate is 1"X or 2250 kb/bytes/second).

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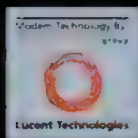
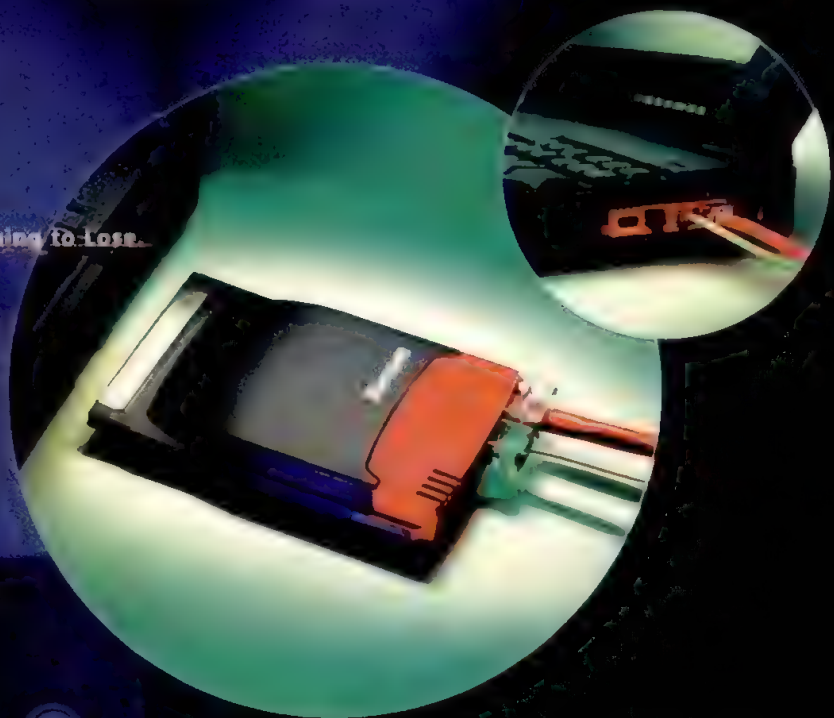
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First Looks

WEB BROWSERS

Surfing Made Simple

Too many bugs in your browser? Check out Opera Software's beautifully simple solution.

By Jim Lynch

Sick of the browser battle between Microsoft and Netscape? Living in fear that Internet Explorer is going to take over your desktop? Tired of waiting for Navigator to load? Opera Software has given all of us a snappy alternative to the browser behemoths.

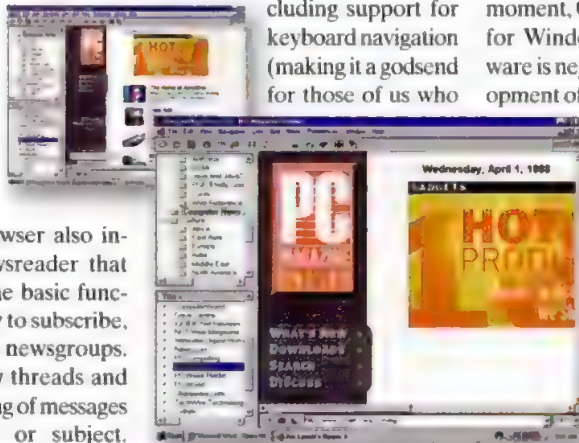
The Opera browser (\$35 street) has a small footprint and will even run on an older 386SX-based PC with only 4MB to 8MB of RAM. Unlike the major browsers, which require a 10MB-plus download, Opera is smaller than 1MB and takes less than a minute to install. This browser has a no-frills yet highly customizable interface.

Don't expect an advanced

e-mail client with lots of options, however. Opera lets you send mail, and that's about it. The browser also includes a fine newsreader that gives you all of the basic functionality necessary to subscribe, read, and reply to newsgroups. You can also view threads and change the grouping of messages by author, date, or subject. Opera's newsreader also lets you print messages, view messages in separate windows, and reply via e-mail. But one feature we missed was the ability to mark message bodies for download, along with headers.

One of Opera's strengths is its ability to load pages quickly. In

most cases, it loaded pages significantly faster than Netscape and IE. Opera also has features not found in the other browsers, including support for keyboard navigation (making it a godsend for those of us who



FORGET YOUR GLASSES? Opera lets you zoom in or out of your favorite Web pages.

hate having to use a mouse). We had the most fun with the zoom-in/zoom-out feature, which can make a Web page gigantic (albeit pixelated) or shrink it down.

There are a few drawbacks to

Opera. It doesn't currently support Java (Version 4.0, due this summer, should), although it does support JavaScript. At the moment, Opera is available only for Windows, but Opera Software is negotiating for the development of a Mac version, and an OS/2 version is in the works.

Once you see Opera in action, you'll want to keep it available on your machine for the times when you truly feel the need for speed.

Opera 3.2. Street price: \$35 per user. Requires: 4MB RAM, 3MB hard disk space, Micro-

soft Windows 3.1, 95, or NT 3.51 or later. Opera Software, Norway; +47-63-84-86-34; www.operasoft.com. Choose 401 at www.pcmag.com/infolink.

UTILITIES

Jazzing Up FrontPage

J-Bots provides some of the Web-page bells and whistles that are missing from Microsoft's FrontPage.

By Jim Lynch

How many of us have wanted to add a few bells and whistles—such as floating windows, status-bar messages, and music—to our FrontPage Web pages but have never had the time to create the code? Enter Webs Unlimited's J-Bots (\$39.95 list).

J-Bots, an add-in for Microsoft FrontPage, lets you set up components to accomplish these tasks and more on your Web site without writing a line of code. J-Bots has 12 different components; all are compatible with Microsoft Internet Explorer 3.0 and 4.0 and Netscape Navigator 3.0 and 4.0.

One component, for example,



BROWSER WATCH! With J-Bots, your site can detect a visitor's browser and then route the visitor to an enhanced version of your site.

displays the current date or time on your Web page. It also detects which browser your visitor is using and redirects the visitor to a version of the page that the browser supports. Another component can detect whether or not

a browser supports JScript and redirects visitors accordingly.

Other J-Bots components can display the last time the page was updated, create separate pop-up windows, and set up Go Back/Forward buttons that

work like the back and forward buttons on browsers. Another component adds a Status Bar Message, which shows a marquee-style moving message in the status bar of the browser window.

J-Bots includes features that generate music and random images (which display graphics from a list, including animated GIFs). The music component adds a background music tag to the page as it

loads in IE or Netscape. Another component turns off page caching; this lets you set a meta tag to keep a page from being cached in your visitor's browser.

We did have one minor gripe with J-Bots, however: Response

can vary according to which browser you're running. For example, some versions of Netscape Navigator may require a plug-in in order to load music components properly.

It's possible to run J-Bots with FrontPage 97, but you need to make a minor modification to the frontpg.ini file in your Windows directory before installing J-Bots. More details on how to do this are available from the Webs Unlimited site.

J-Bots contributes real value to FrontPage 98 by letting you add some useful features to your Web site without having to write one line of code.

J-Bots 2.0. List price: \$39.95 (download, \$34.95); upgrade, \$24.95 (download, \$19.95). Requires: 16MB RAM, 2.8MB hard disk space, Microsoft Windows 95 or NT. Webs Unlimited, Crescent, Iowa; 888-888-4877, www.websunlimited.com. Choose 403 at www.pcmag.com/infolink.



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First Looks

PC THEATER

The Bargain Matinee

TigerDirect's affordable PC Cinema is great for watching DVD movies or surfing the Web.



By Bruce Brown

Taking direct aim at standalone DVD players, the TigerDirect PC Cinema (\$1,399 direct) is optimized for movie viewing and designed to plug into a television set. The PC Cinema forgoes a TV tuner, leaving that function in its usual place. By focusing clearly on DVD film viewing and Internet surfing, as well as adding the ability to plug in a PC monitor and a television set at the same time, the PC Cinema makes a sensible and appealing convergence in an often confusing market.

The system we tested was based on a 233-MHz AMD K6 CPU with a DVD Type II drive and a 4.3GB hard disk. TigerDirect also sells a \$999 version with a 200-MHz K6 CPU and a 2.5GB hard disk. Both versions include 32MB of EDO RAM (expandable to 512MB) and 512K of L2 cache. Other common PC components include an ATI 3D Rage II graphics card, a wavetable audio card, and a K56flex modem.

REMOTE CONTROL

The black-cased PC Cinema also has a Silitek infrared remote control with a joystick pointer and mouse buttons and an I-Point infrared keyboard with an integral joystick. Both the remote and the keyboard have video and audio controls.

The PC Cinema's AV entertainment features include a Sigma Designs RealMagic DVD decoder/MPEG-2 decoder, audio outputs for Dolby Digital, Dolby ProLogic surround sound, and two-channel analog stereo. The product also comes with a stereo audio cable and an SP Diff Digital coaxial cable. The current version has software line doubling for smooth video playback; a version with hardware line doubling should be on sale later this year.

Assuming most buyers will plug the PC Cinema into their own TVs, TigerDirect doesn't include a TV or PC monitor. You connect the PC Cinema using either composite-video inputs or, for better quality, an S-video port (the product includes cables for both). The product also comes without speakers, on the assumption that buyers will plug it into their own stereo systems for stereo, surround sound, or Dolby Digital six-channel audio.

All components of the PC Cinema (including the modem, graphics adapter, DVD decoder,

and sound board) are on separate cards, a more expensive design choice that makes upgrading simple. This design is a clear win over that of standalone DVD players, which are closed consumer-electronics boxes you can't upgrade.

AS A PC

A unique feature of the PC Cinema is that it lets you plug in a PC monitor and a television set simultaneously. Both can display DVD playback or the Windows 95 desktop and applications. You can run the computer display at up to 1,600-by-1,200 (though in our testing with a 15-inch monitor, we ran the system at 800-by-600 and 1,024-by-768 at 16-bit and 24-bit color depths).

The ATI display-settings control panel lets you select the PC monitor, the television set, or both. If just the PC monitor is running, you can set the vertical-refresh rate at a

or office work using a regular monitor at an eye-pleasing refresh rate.

The system opens with a screen that lets you select the DVD player, the Internet (with your choice of browser), or the Windows desktop. Note that you can't play movies in a small window while running computer applications: The system resources must all be available to support playing a DVD movie.

As expected, the TigerDirect unit's benchmark test scores are not competitive with those of hot Pentium II PCs, but for typical family use, the performance is fine. The unit's Winstone 98 score of 16.4 and CPUmark₃₂ score of 475 demonstrate the PC Cinema's performance level. The unit's Graphics WinMark 98 score (93.4), Disk WinMark 98 number (1,120), and CD-ROM WinMark 98 result (1,010) are all respectable; users won't feel that they're lagging when running games and conventional applications.



CONTROL:

The full-featured remote includes a joystick and mouse pointer.

SPIN THAT DVD

Most DVD disks played without a hitch in our testing, with no artifacts, skipping, or hair-comb effects. In one movie, we saw excessive posterization of actors' faces; in two others, there was much less. The facial posterization wasn't noticeable at all on the PC monitor. TigerDirect is investigating whether this was an isolated incident or resulted from a problem with a particular encoding method.

If you're considering buying a DVD player to watch movies but also want to surf the Internet while watching TV, the PC Cinema may be the best bet.

TigerDirect PC Cinema. Direct price: \$1,399. TigerDirect Inc., Miami; 800-830-0056, 305-229-1191; www.pccinema.com. Choose 405 at www.pcmag.com/infolink.



SHOW TIME: TigerDirect's PC Cinema uses software line doubling for smooth video playback.

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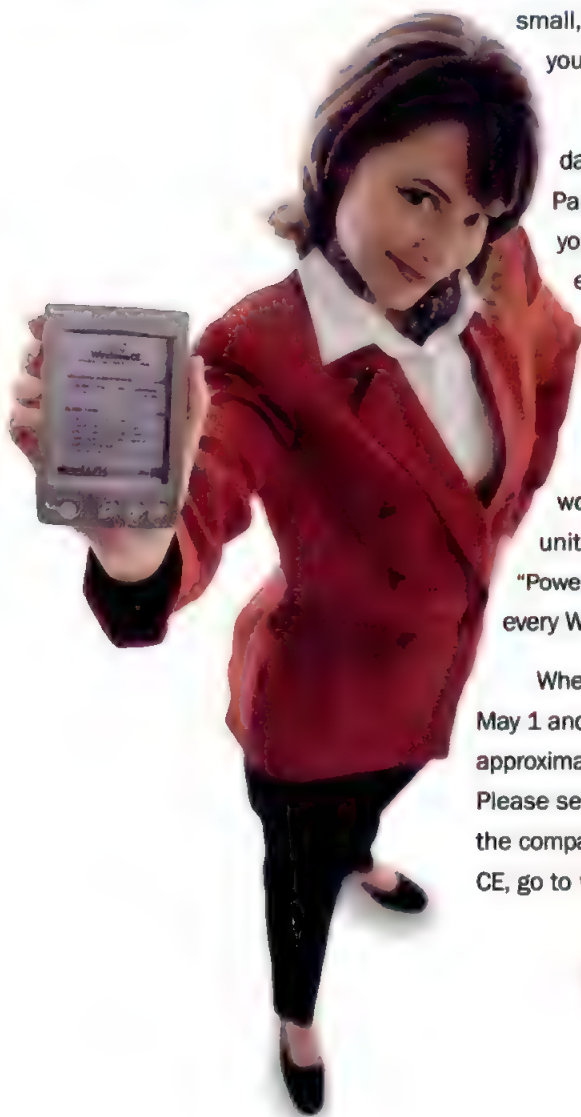
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Second Looks

NETSCAPE COMMUNICATOR 4.05

Browse 3-D Worlds

By Jim Lynch

Firing another shot in the 4.x browser war, Netscape has just released an update to its Communicator suite. Version 4.05 (available for download at www.netscape.com) adds bug fixes, an e-mail utility for Eudora users, and some needed juice to Navigator's Java engine. It also features a bundled VRML viewer.

Netscape has made some significant tweaks to the Java engine in Communicator 4.05. Depending on your platform and system configuration, you'll see a 30 to 50 percent speed increase when loading Java applets. We tested this using a variety of different applets and noticed a significant speed increase when loading applets on our Windows NT test system.

To run your own test, point your browser to our Virtual Labs (www.zdnet.com/vlabs). You'll be able to test your browser's performance, learn more about Java, and join our online discussion. For more applets, check out JavaSoft's applet page (java.sun.com/applets/).

Communicator 4.05 also includes a helpful e-mail utility for those already using Eudora mail. The new version allows you to import Eudora-based e-mail, folders, and settings into Netscape's Messenger mail client. We found the Eudora utility useful, but we were sorry that we didn't have one for IE's mail clients, Outlook and Outlook Express.

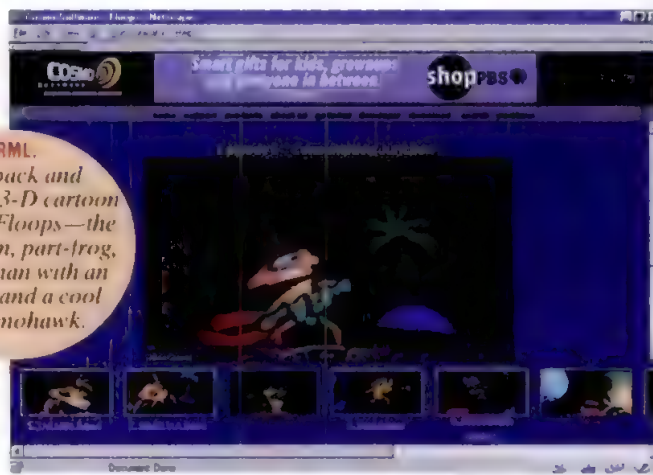
Version 4.05 also has one very cool new feature: Silicon Graphics' Cosmo Player VRML plug-in. Cosmo allows you to view any VRML world without an additional plug-in. We've never been all that thrilled with VRML in

the past, but we enjoyed our experience with Cosmo. After you've downloaded and installed the 4.05 update to Communicator, point your browser to Cosmo Software's Web site (www.cosmosoftware.com) to see some interesting VRML landscapes, games, and cartoons.

Once at the Cosmo site, you'll be able to play "Chomp!", the VRML shark game; check out a panoramic view of the Martian landscape; and watch some 3-D cartoons. Chomp! will teach you how to navigate VRML worlds by letting you play the role of a

VRML.

Kick back and watch the 3-D cartoon antics of Floops—the part-worm, part-frog, part-human with an attitude and a cool green mohawk.



hungry shark trying to gobble up some dinner. Cosmo makes 3-D easy and accessible, even for those without very high-end PCs.

On the whole, we think you'll find Communicator 4.05 worthy of a download. Increased stability,

bug fixes, faster Java, a Eudora e-mail utility, and a bundled VRML plug-in make it a good bet for anyone already using earlier versions of Communicator. IE users may also want to give it a test drive for the same reasons.

O'REILLY WEBSITE PROFESSIONAL 2.2

A Safer Web Server

By Carol Venezia

When we reviewed O'Reilly's WebSite Professional 2.0 intranet Web server ("Web Server with a Smile," January 6, 1998), we were impressed with the product's excellent management user interface as well as its robust virtual-server capabilities.



ties. Since our story, O'Reilly has released two updates to WebSite Professional; the latest, Version 2.2 (available as a free download to registered users of Version 2.0 or 2.1 at oreilly.website.com) bolsters security features and broadens options for Java developers.

Version 2.1 of WebSite Professional adds up to 164 bits of support for full-strength encryption (note, however, that this 164-bit encryption is available only to

users in the U.S. and Canada, because the U.S. government restricts the export of high-security software). This level of security is delivered using SSL (Secure Socket Layer) 3.0.

The new version (Version 2.2) adds even more useful features, starting with the upgraded iHTML Merchant 1.02 and iHTML Professional 2.12, both of which are available from Inline Internet Systems. The former supports Cybercash along with both PC Authorize and Do Pay as payment methods. It also allows all banner ads to be included in a single directory. The latter features system stability as well as numerous improvements to logging, error handling, and tags.

You'll also find Uplink in this upgrade, which is O'Reilly's new utility designed for Internet content and service providers. Uplink (which supports SSL-3) lets

clients or partners publish to a site without compromising the security of that site. WebSite Professional 2.2 includes a royalty-free license for distributing Uplink to your users and customers.

O'Reilly has also enhanced WebSite Professional's log-file management and generation, which makes it easier to get Web traffic reports. For easier access and archiving, the software now automatically cycles log files by date and file size.

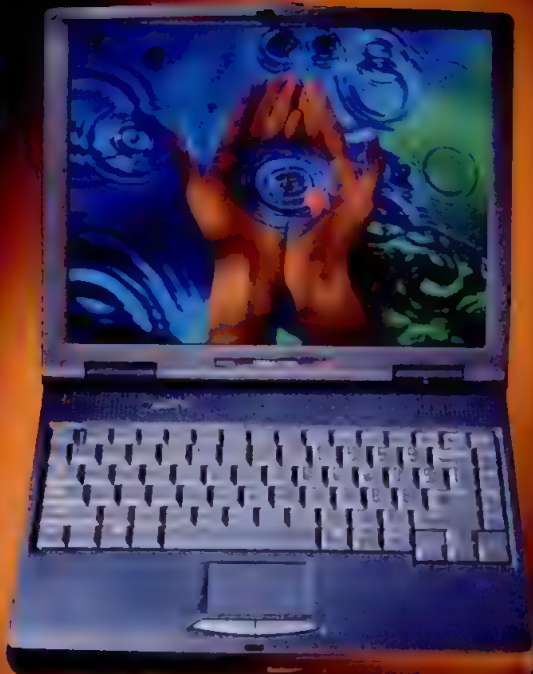
Developers also have more options for Java servlet development with this upgrade. Live Software's new JRun 2.1 is included, which adds support for Java Development Kit (JDK) 1.2 of the JavaSoft Servlet Advanced Programming Interface (API) 1.1 and Java Foundation Classes (JFC) 1.1 for remote administration of servlets.

If you're a WebSite Professional user, Version 2.2 is well worth the time it takes to download.

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“Thin is in, and NEC's Versa 5080, at 4.9 pounds and 1.5 inches thick, is a power user's full-featured laptop with a waifish form factor.”

BYTE Magazine - Mar. 1998

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- 5.0" and 1.5" Thin

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- Lithium-Ion Battery
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- PCI Bus Architecture with NeoMagic 128-Bit Graphics Accelerator
- Integrated 16-Bit Stereo Sound
- 32-Bit ColorBus and Zoomed Video Support
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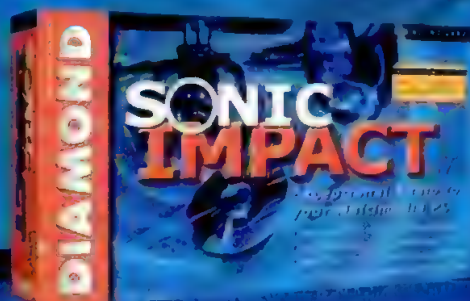
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Trust Me?

Is spam a form of electronic commerce? If so, it's one of the chief obstacles to the kind of e-commerce that we typically think about: going to a Web site, selecting a product, paying for it, and having it show up a couple of days later. Most people I know are

wildly averse to spam—electronic junk mail—for a variety of reasons. Internet altruists fret over the huge amount of bandwidth it consumes—up to 40 percent of a day's postings on Usenet and perhaps 15 to 20 percent of all e-mail traffic. Managers fret about employees getting mail at work that is, in effect, addressed to “occupant.”

Everyone rankles at the deceptive sender and subject lines, designed to lure you into opening the message. Privacy advocates want to know just two things: How did you get my e-mail address, and what else do you know about me?

Objections such as these can make you nervous about giving personal information to Web sites, especially when you hear stories about sites being able to harvest your address merely if you surf to them. (True: Check out www.javascriptsource.com. In the User-Details section, look at the script for Visitor Monitor. Or look at www.13x.com/cgi-bin/cdu/snoop.pl.)

If you can't even surf to a site without coughing up your e-mail address, you're likely to have more than a moment's unease about turning over your name and address and other registration information. No one publicizes the fact today, but it's clear from the personal experiences of Web users that spammers are using this technique to collect addresses.

How do you know how a site will handle your personal data? One group of concerned Web activists has formed TRUSTe (www.truste.org), a nonprofit corporation that certifies Web sites' privacy statements. (Privacy is separate and distinct from security, which involves encrypting your transactions to prevent fraud or theft.) A TRUSTe-certified statement will tell you in plain English exactly what information a site garners about you, what it does with this information, how it handles your transactions, and what recourse you have if any of the above is not to your liking.

One of the charter sponsors of TRUSTe is Lands' End, the clothing company, which has an extensive online catalog and is well known for its enlightened customer-service policies. If you go to the Lands' End site (www.landsend.com), you'll see the TRUSTe logo at the bottom of the page. Click

on it and you'll see the privacy statement issued by Lands' End. The company asks for your name, address, telephone number, and e-mail address in order to do business with you electronically and requests a credit card number if you place an order. The message states further: “If you do request a

catalog or order a product from Lands' End you will be put on our ‘House File.’ Our House File is a large database of Lands' End customers. We do sometimes trade names with other companies whose products and services might interest you.” The message then informs you that, in case you don't want your name exchanged with other companies, you can call an 800 number or send e-mail to have your name removed from the exchange list.

The Lands' End TRUSTe statement also says that the company does not currently do any kind of *profiling*—tracking of your online behavior and drawing conclusions about your interests—at the company site, nor does it use cookies to track your session. Instead, Lands' End creates a unique “state ID,” a random number generated by a server-side script that keeps track of the products you've ordered.

I find this technique vastly preferable to cookies, even though they are rather benign; the privacy and security concerns about cookies are mostly overblown. I just don't like things written to my disk without my knowledge and permission. I also don't like systems that say: “Welcome back, Bill! This is your 247th visit to the Fantasy Shop!” It creeps me out,

kind of like people with Caller ID who answer the phone by saying, “Hi, Bill,” instead of “Hello.”

Finally, and perhaps most important, Lands' End clearly states that it keeps no customer information on the Web. So even a determined hack attack against the company's servers will not yield your name, address, or credit card information.

Other TRUSTe members have similar statements at their sites. You don't have to be a TRUSTe member to have a privacy statement at your site, but the fees companies pay to TRUSTe let auditors verify the privacy statements, in an effort to bolster your trust even more. Furthermore, these companies are good role models for the rest of the Web. **PC**

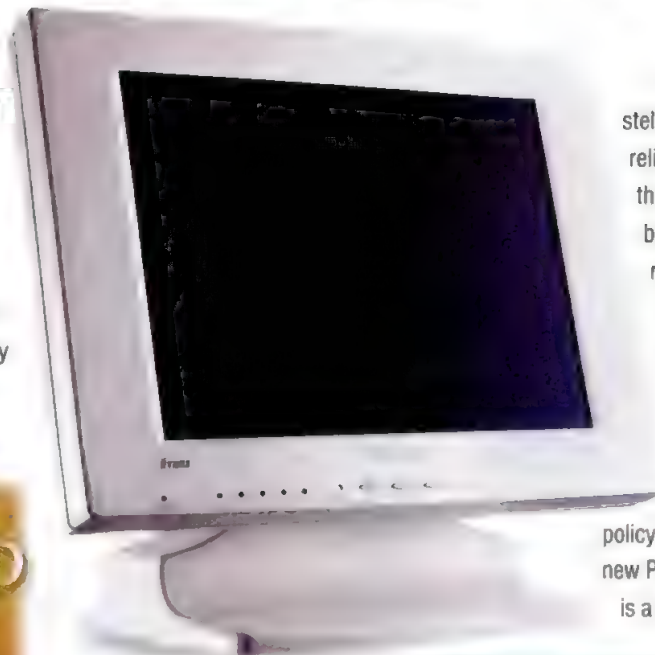


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Maximum Resolution	1024 x 768
Dot Clock	75MHz maximum
Power Consumption	27W maximum Power Management: APM (optional)
Dimensions/Net Weight	15.4" x 14.2" x 3.1" (H x W x D) / 2.3 lbs.
Tilt/Swivel Angle	Upward: 30° (optional)
Adjustments	CE, TUV, UL, FCC, ISO 9241-3 / ISO 9241-8, FCC-B, TCO 95, UL/CUL, VCCI-B
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Paying the Price for ISDN

Having just brought my ISDN line back up, I couldn't resist trying the 3Com ISDN Office Connect LAN Modem. With a built-in four-port router and two analog-out phone jacks, it's almost perfect for a small home office. But what caught my attention is the

assertion that you can have it running in 15 minutes or get your money back. If you can get ISDN working in a weekend, you should be happy. Unfortunately, the phone company is clueless and of little help.

The 3Com modem didn't install in 15 minutes for me, but it should self-install at 90 percent of locations in 15 minutes. The internal software is excellent. But the coders obviously never got the correct SPID information for my Oakland switch, which apparently has a numbering system unlike any other in the state. Curiously few people at Pacific Bell even knew how this switch handled SPID numbering, and I had to call outside the company to find out. Pacific Bell's ISDN labs were decimated after a bone-head decision was made to hire a sales guy to run them. Most of the rest of the staff left shortly thereafter. Then the sales guy quit, and now the lab is gone. A technician at Pacific Bell told me that the last expert on the big AT&T ESS switches is about to leave, too. For practical purposes the various phone companies with their vaunted big switches are losing all the people who actually know and can operate this gear.

None of this surprises me. About two years ago I was speaking at a Sun Microsystems developer conference, and some network guys from New Jersey told me that NYNEX had already lost many of its internal superstars. "It's pretty scary when you have to tell them how to program their own switches," one told me. The point is not that everyday problems cannot be solved by the field personnel, but when complex issues arise, problems compound. And since the phone companies are more interested in marketing than technology, there's no evidence that this is going to improve.

The irony here is that free voice over IP will eventually save these people. As the expertise over the switching gear dwindles toward nil, IP telephony will eliminate the need for this old big iron. The only thing to prevent this from happening is the phone companies' unworkable and plain stupid tariff structure. That of course is made worse by the companies' desire to make as much money from long-distance connections as they can for as long as they can. If the crossover point

to IP telephony is not timely, then the various alternative telephony mechanisms (including telephony over cable) will bankrupt the phone companies.

Here's what I'm complaining about: When ISDN was first deployed, it was going to cost \$40 a month with unlimited

local calls, plus a two-year commitment. Now there's a per-minute usage fee. Worse, the first minute is charged at three times the rate of additional minutes. This ruins the concept of the virtual connection and encourages people to stay online, which I assume the phone company wanted to avoid! The reason to institute a per-minute fee is to prevent everyone with ISDN from setting up servers 24-7 year-round. There are probably about ten users who want to do that.

Most modern ISDN systems are set up with virtual connections or connect-as-needed implementations. You open the browser and click on something and the ISDN line connects, grabs a page, and disconnects. This minimizes bandwidth hogging and should be encouraged. But each connection costs 3 cents, and you get 1 minute of connection time. For each additional minute you pay 1 cent. So going online for an hour costs 62 cents. If you view 25 Web pages using a connect-as-needed approach over, say, an hour, you may be online for as little as 5 minutes. But the charge is 75 cents. So do you want to pay 75 cents for 5 minutes or 62 cents for an hour? What kind of thinking is going on at the phone companies? Obviously nobody

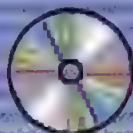
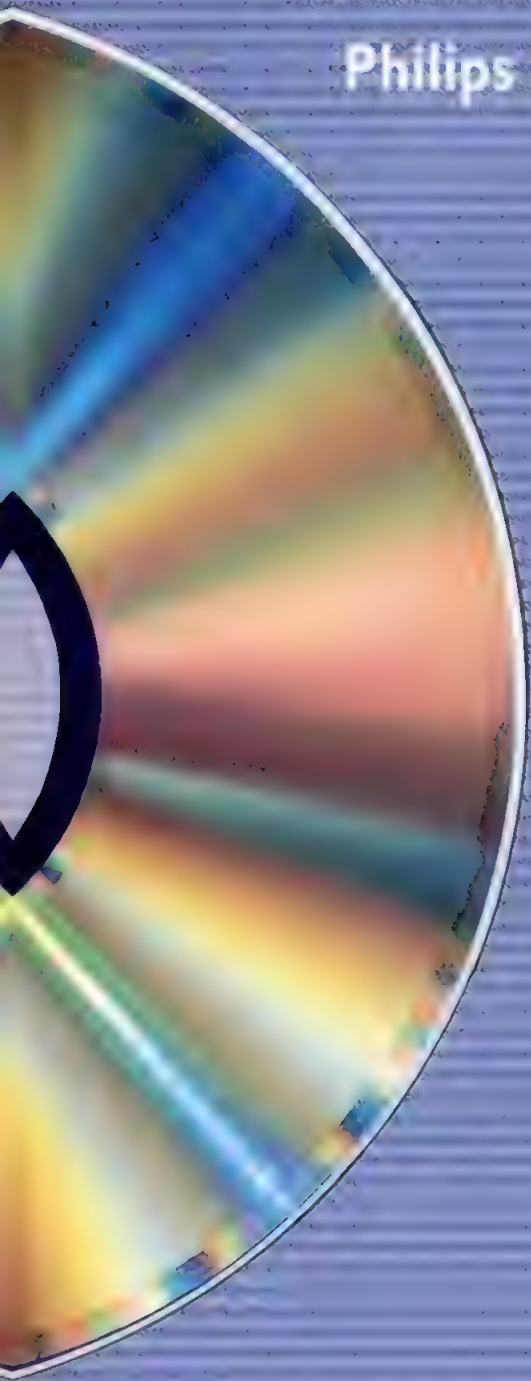
has a clue as to how this works. In fact, if the first minute were free, people would be on and off like lightning.

Meanwhile, most people get a 56K modem and standard phone service, and they stay online all day long. This is not because they're serving pages: It's because they want that connect-as-needed feeling. People, especially with POTS, don't want to wait for the dial tone, then the dialing, then the arduous handshaking and slow connection. Staying online is just easier; thus, bandwidth is tied up. Then again, maybe the phone companies are encouraging back-assward thinking to keep the Net clogged and inefficient. All they are doing, in fact, is writing their own obituaries.



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Inside Track

Bill Gates predicted Motorola **would be out of the microprocessor business** sometime next year. Meanwhile, the company actually dominates a number of markets, including game machines, automobile computers, and—as the 3Com PalmPilot continues to sell **like crazy**—hand-held computers. The PalmPilot machine is based on the Motorola 68328, **code-named Dragonball**. There's a cartoon series in Japan highlighting a **small superhero** with the same name. In fact this chip, combined with the memory in a PalmPilot, is more powerful than the second-generation Macintosh, the Mac 512K.

While Cyrix has been getting a lot of ink for the Media GX, its multi-purpose processor, Motorola **has been overlooked** for its MC683xx line of chips, each of which incorporates all sorts of combined features. The 68328 was introduced to the world in the summer of 1995 and with **over 2 million sold** is on a steep upward sales slope. The small surface-mount chip delivers 2.7 MIPS at 16 MHz and incorporates perhaps 20 components plus a CPU. This includes an LCD controller, PCMCIA support, UART, and other subsystems.

While Intel, with its IA-64, goes after the high end, the low end is being eaten away by the competition. **One company to watch** in the hand-held arena is The Windward Group in Los Gatos (408-395-9442, www.wwg.com). Once known only to insiders, this long-established development group (started by ex-GRiD executives) is probably **responsible** for much of the PalmPilot's success. Besides doing development for everyone from IBM to Intuit to Apple, it created most of the software you get with the PalmPilot, including Pilot Desktop. The Windward Group also **developed the HotSyno application**, which I believe is the key to the PalmPilot's emergence as a must-have device. If you want to develop a palmtop or a related application, start with these guys.

I had a long chat with the VP of marketing at Windward to get a feeling for the **current state** of the industry from the top developer's perspective. A couple of things came out of the conversation, including **the fear** that the Pilot is analogous to the Macintosh. Many Pilot enthusiasts think 3Com should **license this OS and hardware design** before Microsoft stumbles on the right formula. **Apple waited too long, and then it was too late.** This assessment may be correct, but thinking that way is hard when a **cash cow** is delivering good milk.

One other thing Windward told me that might concern Microsoft is that there was almost **no interest from anyone in developing apps for Windows CE**. I assume that there are three reasons for this: (1) Nobody is

Many Pilot enthusiasts think 3Com should license the OS and hardware design before Microsoft stumbles on the right formula. This assessment may be correct, but it's hard to think that way when a cash cow is delivering good milk.

buying the Windows CE machines; (2) everyone assumes that Windows CE machines will just run the same **big** Windows apps that Windows 95 machines run; (3) software companies assume that eventually Microsoft will **muscle them out** of the Windows CE business anyway, so why bother?

Look for **Palm III sales to zoom** when the IR port gets full utilization. IBM is working on doing an **IR-to-IR link** between the Palm III and its line of IR-equipped ThinkPads. Everyone expects to see fancy TV controllers developed as apps for the device, too. This would include something like a download of *TV Guide*, and with the touch of a pen you'll be able to choose in advance which TV shows to watch. The Palm III will change channels and **turn on**

the VCR when it sees that your TV viewing is interrupted by a meeting entered in your date book. You won't miss that episode of "Law and Order" you wanted to see. Hot stuff.

Recently Microsoft released **Windows CE 2.0** and found the same cast of characters trying to figure a way to utilize its increased power. Hitachi, HP, and NEC decided that a new **weird class of computers** (that nobody will want) is just the ticket. These machines fit somewhere between a PalmPilot and a subnotebook. You know, kind of like the Toshiba Libretto, **only cheaper**. Hey, maybe it's just the price that's the problem.

Hitachi and HP are going to use the Hitachi SH-3 CPU for their machines, and NEC will use the VR4111. This should **cause some consternation** at Intel. And it should cause some **confusion** in the market, though I don't think this kind of machine will ever develop a serious market. People who need such a machine are served by the IBM 560X and the Toshiba 600CT. Of course, if people ever asked me what I think of things, **nothing** would ever get built!

Meanwhile, Intel and Microsoft are going to **be at odds again** as Microsoft is now beginning to **promote the FireWire (1394) port** over the USB, which is just starting to get used. Intel's AC-97, an audio codec specification, has the USB in mind as I/O. But despite the fact that no computer I've ever seen has a working FireWire port, Microsoft is using a marketing gimmick called an MDA (market development agreement), in which Microsoft pays any computer company a "cash incentive" for incorporating this feature. Windows 98 has direct support for a TV tuner. Something called **WebTV for Windows** (a weird concept if ever there was one) will somehow be incorporated into future low-end machines. Seems pointless to me, and exactly why Microsoft wants the 1394 is unclear. If someone can figure out what the company's up to, let me know. ☐

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Internet Taxes on the Way

Your friends and mine in Washington are at it again. Eager to save us from a grave and imminent threat—always a popular theme in our nation's capital—they're lining up behind new legislation billed as the Internet Tax Freedom Act.

Experienced Beltway hands will immediately recognize from that moniker the likely outcome: the Internet Tax Inevitability Act. Washingtonians love Newspeak, and a basic principle of the political flavor of Newspeak is to call things exactly the opposite of what they really are.

Moreover, this legislation, which is now barreling down the track toward passage, is billed as a milestone for Web-surfing consumers. Yet among the four constituencies it serves, consumers come in dead last. Again, no surprise.

The bills—H.R. 1054 in the House and S.B. 442 in the Senate—have been in gestation for about a year. This spring, they surfaced to a general lack of coverage in the media and to general praise among the panjandrums of Washington, who had been carefully prepared for their emergence by the lobbyists behind the bills.

As often happens, these bills at first appear to bring reason and order to a chaotic world, to the benefit of everyone involved. In fact, the messy compromises necessary for delivery to the cusp of passage have wrung a lot of the reason and order out of them. The problems they address are certainly real and dangerous, but their answers are half-hearted at best and smack of yet more feel-good, let-us-worry-about-all-this Potomac Prozac.

You may want to get involved.

A little history: Politicians everywhere are intrigued by the emergence of Internet commerce and, true to form, see it as the Holy Grail, a new source of tax

revenues. Across the U.S., there are about 30,000 political jurisdictions—cities, counties, states—with taxing authority, and a fair number of them have been trying to levy taxes on Internet transactions. Naturally, there is little agreement among them about rates and kinds of taxes, which threatens to produce a Tower of Babel tough to navigate for consumers and Internet merchants alike.

As many observers have pointed out, it would be easy to harm grievously, if not quite kill, so new and still-forming a notion as Internet commerce with a welter of confusing and perhaps oppressive taxation.

Hear that rumbling? That's the Feds riding to the rescue.

After extensive consultation with Silicon Valley Inc., Congressman Chris Cox of California last year introduced H.R. 1054, the one he likes to call the Internet Tax Freedom Act. Sounds good, huh? We'll protect the Internet and its users from new taxes, right? Err... well... no.

The ITF would establish a moratorium of three years, during which local and state taxing authorities couldn't levy new taxes on Internet transactions. In that time, the Feds and states would confer, consult, and cogitate on how Internet taxation *ought* to work, so that when the moratorium expires, they'll be ready to pop us with a new, integrated, nationwide Internet tax scheme.

See why I say the bills are a case of deceptive packaging worthy of a Federal Trade Commission inquiry?

Washington and Internet industry lobbyists defend these bills with the argument that Internet transactions are going to get taxed anyway, sooner or later, so why not just sit back and let Uncle Sam figure out how we'd like to be taxed? We don't need to worry our pretty little heads about this...

At this writing, H.R. 1054 is about to be considered and almost certainly passed by the House. S.B. 442 is due to come up in the Senate in late spring. The two bills are not the same, but since their passage will result in a negotiated compromise between the two, the bills' backers are confident that by midsummer they'll have what they want. President Clinton said in March that he'll sign pretty much whatever Internet taxation bill the Congress passes.

Who benefits from this? Clearly, Silicon Valley Inc. does: A stable, predictable path toward gouging Internet users in a few years ensures that Web startups and related companies won't have to deal with a fragmented tax situation.

States and cities benefit too; at least, they do after Congressman Cox announced in March that he had brokered a compromise with the National Governors Association and the National League of Cities. Originally, they'd been dead set against this kind of federal limitation on their discretion.



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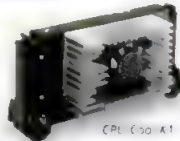
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But Cox whittled down the term of the moratorium from seven to three years and watered down H.R. 1054 in other ways to gain the states' and cities' approval. After all, the governors figured, if they continued to act on their own, they'd have to defend a flood of messy suits by taxpayers outraged by these new levies. But if, in just three years, they can act under the protection of federal law, they can have their way with us without worrying about complaints regarding equity and justice.

Finally, Web merchants have been persuaded they will benefit, because they'll have a simple, consistent tax schedule to deal with when we buy from them. They're less worried about the competitive aspects of new Internet taxes—after all, their competitors will bear the same burden, but it's the buyer who gets bitten in the neck—than they are about dealing with 30,000 different tax rates and rule books.

And consumers? Well, we come last in Washington's priorities, so we get clobbered with an institutionalized tax hung round the neck of our Web purchases.

In many ways, the battle over Web taxation is an extension of the long-standing battle between mail-order merchants and state attorneys general over whether state sales taxes should apply to purchases made from another state. The attorneys general have become increasingly aggressive about this, driven both by their legislatures' demands for new tax sources and by the complaints of their merchant constituents. After all, says Merchant A, if a sale were made right here at my store in Mudville, Mrs. Phillips would have to pay sales tax on that sweater. Why should she be able to evade that tax, and put me at a competitive disadvantage, just by buying it over the phone—or over the Web?

There is a primitive justice to the merchants' complaints, just as state legislators' cries against loss of taxes make some sense. But both groups are functioning in an increasingly obsolete world, a regional and parochial one, not in the new global world of the late nineties—and especially of the 21st century.

You can read the text of both bills (and their sponsors' breathlessly self-serving prose) at www.house.gov/chriscox/ for Congressman Cox and at www.senate.gov/member/or/wyden/general/ for Senator Ron Wyden of Oregon.

Let them know what you think. And contact your own representative and senators too, if you think the Internet Tax Freedom Act smells like a setup. **PC**

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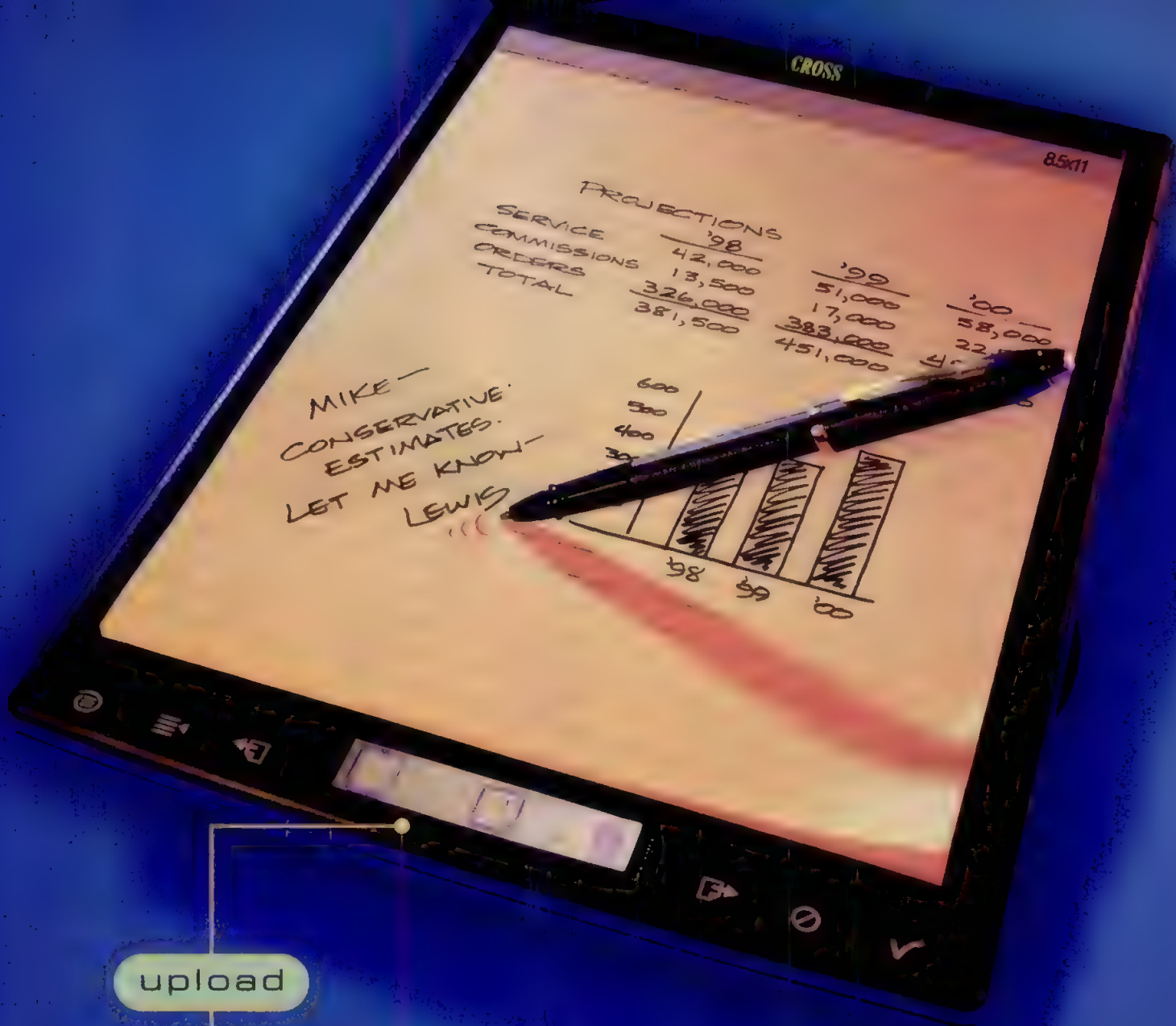
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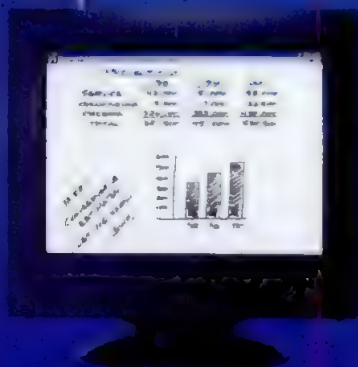
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The Converging Notebook Market

When three lanes merge to two on a crowded highway, somebody might get squeezed off the road. With notebook computers, we'll see the three current categories become two by year's end. High-end notebooks will be left by the side of the road.

Value notebooks are adding high-end features and performance; go-anywhere subnotebooks now have removable CD-ROM modules, and high-end notebooks are shedding weight and coming down a bit in price, but perhaps not enough. There's just too much similarity to support three broadly marketed model lines, especially when dealers in the retail channel are clamoring to sell fewer models but in greater volume.

When Intel announced its Mobile Deschutes Pentium II processor at the beginning of April, many of the products on display were value or subnotebook PCs. They already had 13.3-inch active-matrix displays and 4GB or 6GB hard disks. You're talking about the capabilities of a \$5,000 notebook computer but for a lot less money or in a lot less space.

Here's how the market will shake out.

Value notebooks. Toshiba Satellites and their kin will be the mainstays in business fleets and small businesses and among home buyers and students. They will sell for \$1,000 (late this year) to \$3,000, with the main price band at \$2,000 to \$2,500. The attraction for IS managers is that many of these are three-spindle notebooks, meaning that there's room for the hard disk, CD-ROM, and floppy disk drives all at the same time. Some companies say they lose half of all outboard accessories in the course of the year, so anything that can be kept inside the computer helps control the total cost of ownership.

Subnotebooks. Right now the system weight is 4 to 5 pounds, counting the internal battery but not the charger or external floppy disk drive. Providing room for an internal 5.25-inch drive adds a quarter inch of height and half a pound of weight if you don't fill the second bay, which can hold a floppy disk drive, a CD-ROM drive, a DVD drive, a 100MB-plus ultra-floppy disk drive such as the Zip or LS-120, or a second battery.

High-end notebooks. When you buy an IBM ThinkPad 770 or a Toshiba Tecra, you get a bit more capacity and a few extra bells and whistles in a slightly bigger, somewhat heavier box, for which you pay a healthy premium. This category is where you'll most likely find a 14-inch display, a taller hard

disk bay, or an MPEG decoder option, for instance. There are always people who need this kind of luggable horsepower, which is why these big honkers won't ever go away completely. To survive, they may go upmarket. A year from now I can see a high-end notebook with dual Mobile Deschutes processors, a 15GB 2.5-inch hard disk, a 15-inch 1,600-by-1,200 display, AGP video, an 8-pound weight, and a \$7,500-to-\$10,000 price tag. This will be bought by people who now air-ship Windows NT or Unix desktop workstations when they work off-site, as well as people who must have the most outrageous notebook because, like Everest, it's there.

Two of the most impressive examples of the do-everything, two-spindle subnotebook are the Sony VAIO 700 series and the just-out IBM ThinkPad 600. Sony has a superb docking station—with built-in SCSI, networking, digital video capture, another drive bay, and a second-battery charger—and you can put a second main battery in the open drive bay. Some notebooks use a separate battery of a different size for the second bay, a minor but real-world hassle. The ThinkPad 600 is an offshoot of the all-conquering 4.1-pound one-spindle ThinkPad 560 that almost single-handedly legitimized the subnotebook market in the past two years. Because IBM has done so well with the ThinkPad 560, it will remain on the market. But this is the exception that proves the rule. Most vendors won't have enough sales volume to justify two subnotebook variants.

Two sub-subnotebook categories bear watching. First are 3- to 4-pound x86 Windows-based machines such as the Toshiba Libretto and the forthcoming Sony PCG-505. Think of them as real notebooks with everything scrunched—keyboard, screen, hard disk, battery, and battery life. Also watch the Jupiter class of Windows CE machines. These will weigh 2 to 2.5 pounds and will be light-duty e-mail fetchers and note takers with limited storage. IS departments may or may not like the machines, because they'll mean one more type of operating system to support. The Jupiter machines will cost about \$1,000—not much more in today's dollars than the eight-line-display Radio Shack Model 100 cost in 1983. **PC**



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2001 Computing in the New Millennium

"I KNOW YOU AND FRANK WERE PLANNING TO DISCONNECT ME, AND I'M AFRAID THAT'S SOMETHING I CANNOT ALLOW TO HAPPEN."—2001: A SPACE ODYSSEY

The HAL 9000—now there was a computer for 2001. Great user interface, wireless communication from Jupiter, and a home automation system that failed to open the pod bay doors only once. It was also the 1968 film's grand metaphor for mankind, which—like HAL—had become so advanced that it was forced to return to a childlike state. Of course, the likelihood that a computer will be that advanced in 2001 is about the same as that a

science-fiction film today would convey so subtle a message.

This special issue of *PC Magazine* is dedicated to our view of the 2001 computer, drawn for the most part from

what is already known about technological advances in microprocessors, storage, displays, the Internet, and software. Though it may not all add up to a computer as advanced as HAL, remember that HAL

was a monolithic machine that served—and finally controlled—many people. As long as the 2001 computer is still a *personal* computer, there won't be any argument about who gets to turn it off.

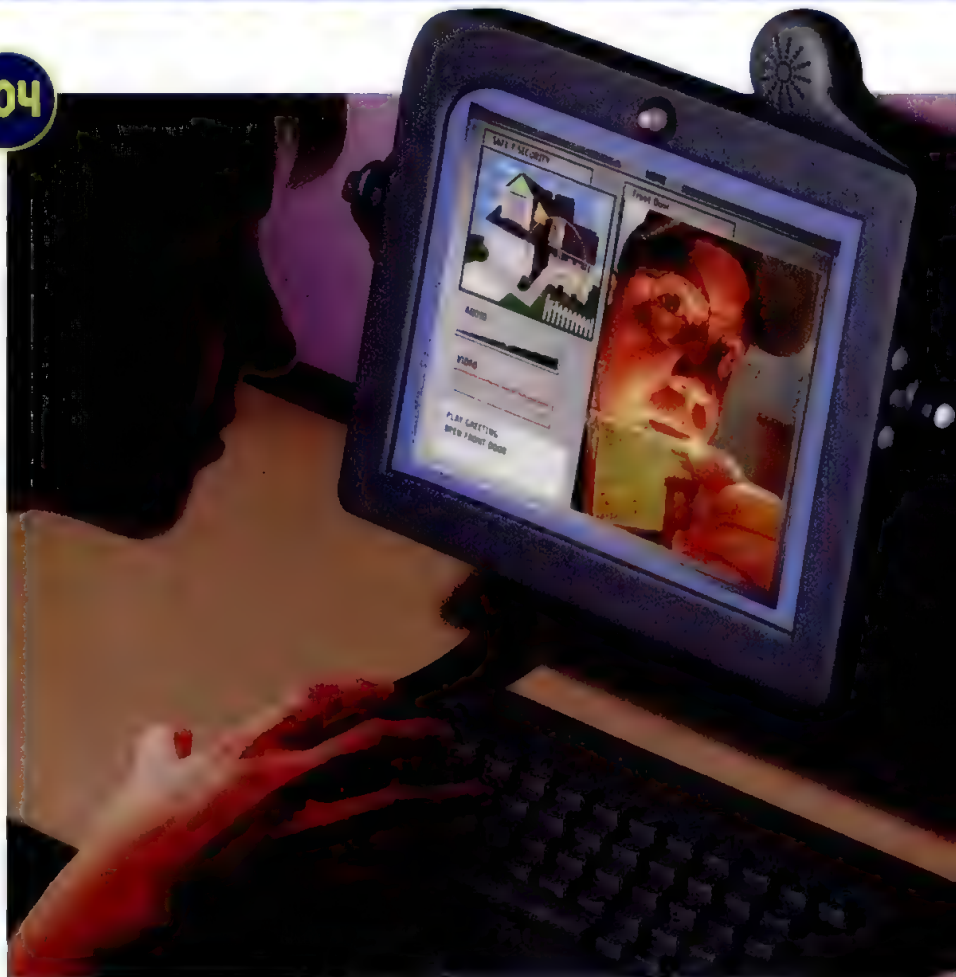


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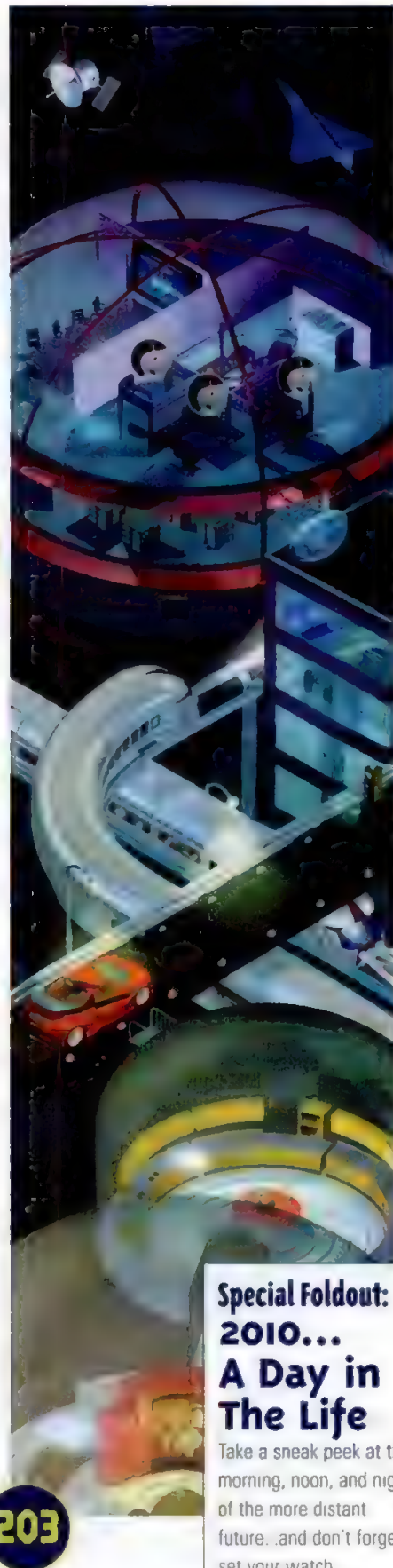
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Special Foldout: 2010... A Day in The Life

Take a sneak peek at the morning, noon, and night of the more distant future... and don't forget to set your watch

Microprocessors

PCs will become more powerful and users will have more choices,
as more chip makers compete in the microprocessor arena.

By Michael Slater

IN 2001, PCs SELLING FOR \$700 OR LESS will be faster than today's top-of-the-line systems, thanks to the dizzying pace of microprocessor advances that to date have doubled performance every 18 months.

The fastest systems of the future will offer several times the performance of today's PCs, delivering more realistic 3-D graphics, flawless video, and quicker processing of digital photographs. The PCs will also enable a new wave of software innovation, including richer user interfaces.

Although PC users have grown accustomed to microprocessors offering more power with each passing year, the next few years will bring them something new: more choice. After years of closely following Intel's lead, microprocessors for PCs will splinter to an unprecedented degree in instruction sets, bus interfaces, and cache architectures.

This is not to say that PCs won't remain dominated by the x86 architecture. The assault of the RISC chips is essentially over after years of struggle. The PowerPC chip is limited to Apple's Macintosh, and the Mac's market share is down to 3 percent. Alpha, the only RISC processor currently supported by Windows NT, will hold a small high-end niche for a few years but isn't likely to have much impact in the mainstream. Perhaps the biggest microprocessor event of 1999 will be

Intel's introduction of the first IA-64 processor, code-named Merced. This processor, with a 64-bit instruction set, will not target PCs (with even the most powerful operating systems capable of handling only 32-bit instructions), but instead Merced will renew the attack on the server and workstation markets.

Although IA-64 processors will run x86 programs, they will require programs compiled for the new 64-bit instruction set to deliver higher performance than contemporary x86 chips. In addition, Merced will be too expensive for PCs until it is shrunk to use a more advanced manufacturing process. So IA-64 processors will not be relevant to the PC market until 2002 or later.

One demand-limiting factor for IA-64 in PCs is a shortage of applications that require such high performance. Aside from 3-D games and a few niche applications, PC applications may not need more performance than today's midrange processors. And by the time IA-64 processors are ready for the PC market, the fastest x86 chips will be ten times as fast as they are today. If PC users are going to care about ever-faster microprocessors, software developers will need to be more creative about finding ways to deliver value from these fast processors.

This year, Intel's big push will be the

market's conversion from the Pentium family, with its Socket 7 interface, to the Pentium II family, with its Slot 1 interface and its derivatives. Socket 7 is a 296-pin socket used by Pentiums, the Advanced Micro Devices K5 and K6, the Cyrix 6x86 and 6x86MX, and the Integrated Device Technology C6. Slot 1 is a 242-contact slot accessed by a single-edge contact (SEC) cartridge.

To drive Pentium II down to entry-level systems, Intel is introducing a new product line with a new brand: Celeron. The first member of the line, code-named Covington, is a Pentium II with no L2 cache. Think of this chip as the Pentium II SX: Just as Intel's goal with the 386SX was to kill off the 286, and with the 486SX to end the 386, Covington's charter is to eliminate the Pentium's role in the market.

Covington will be cheap, but it won't be especially speedy, so performance won't drive its success. Acceptance will come instead from low pricing and an ability to let PC makers create a broad product line from a single motherboard.

Much more interesting is Covington's follow-on, due by year's end, code-named Mendocino. This chip, which will presumably carry the Celeron brand, will integrate 128K of L2 cache on the processor chip, run at the full processor speed,

Projected Processor Road Map After years of following Intel's lead closely, microprocessors

CHIP MANUFACTURER	1998		1999	
	1ST HALF	2ND HALF	1ST HALF	2ND HALF
AMD	K6/266; K6-3D/300, 350	K6+3D/350, 400	K7	
CYRIX	6x86MX/PR266*, PR300*, PR350*	MX+/PR300*, PR400*	Jalapeño	MX+
IDT	C6+/300	C6+ with L2/300	C7	
INTEL	Deschutes/350, 400; Celeron/266 (Covington); Mobile Pentium II/233, 266	Pentium II for servers and workstations/400, 450; Celeron/300 (Mendocino); Mobile PII/300	Katmai	Merced

and deliver a big performance boost.

Intel's competitors are moving forward this year with the Socket 7 approach, increasing the bus speed to 100 MHz. Like Intel, AMD and IDT will offer chips with integrated L2 caches, allowing continued increased performance without moving to Slot 1.

As Intel abandons the Socket 7 infrastructure, other companies will offer a Socket 7 chip set with an Accelerated Graphics Port, offering high performance graphics at mainstream prices. The split in the infrastructure is reminiscent of previous transitions, as when Intel moved to Pentium and its competitors continued to speed up their 486 offerings.

The split in the instruction-set architecture that will occur this year is unprecedented, however. Whereas competitors had followed closely in Intel's footsteps, AMD, Cyrix, and IDT all plan to introduce processors with instruction set extensions designed to speed up 3-D geometry and lighting calculations. All three chip makers had initially planned to implement their own proprietary extensions but have now agreed on a common standard.

Intel will introduce its own 3-D instruction set extensions in 1999 as part of the processor code-named Katmai. In the meantime, competitors will have their biggest feature advantage ever over Intel. But this advantage will benefit users who care only about certain high-end 3-D games.

After Intel discloses the Katmai new instructions, competitors will race to include Intel's instructions in their chips. The non-Intel extensions may persist as an option, but their use is likely to be rel-

atively short-lived. Still, supporting both may be relatively easy, depending on market share at the time.

Several PC microprocessor makers will introduce another round of processors in 1999. Intel's Katmai will be based on the Deschutes CPU core but will add the Katmai new instructions and probably have larger on-chip Level 1 caches. Others, such as the AMD K7 and the Cyrix Jalapeño, will be entirely new CPUs.

AMD's K7 will depart from the Intel-defined buses, using neither the Socket 7 bus nor the Slot 1 bus. Instead, the company plans to use a bus design licensed from Digital Equipment Corp. that was originally created for the 21264 Alpha processor. AMD plans to use the same physical module size and connector as Intel's Slot 1, minimizing the mechanical changes, but the signals on the connector will be different. AMD calls this design "Slot A."

Although the Alpha bus is fast and appears to be a good technical solution, it will present a new challenge for AMD. For the first time, AMD will not be riding on the infrastructure created for Intel processors; chip sets and motherboards will have to be created explicitly for the K7.

In October 1997, Cyrix revealed the internal architecture of its next processor core, code-named Cayenne. With 15 new multimedia floating-point instructions, Cayenne will enable high-performance 3-D graphics, DVD, and 3-D audio. Processors based on this core should

start production during the second half of this year, with the PR300 (performance rating comparable to an Intel Pentium II/300).

Cyrix has not disclosed its bus plans, but the company is likely to build Pentium II-compatible modules using the Slot 1 architecture. In negotiating the renewal of its cross-license patent agreement with Intel, AMD gave up its right to build Slot 1 processors. But Cyrix, now a subsidiary of National Semiconductor, has the benefit of National's license, which has no such exclusion.

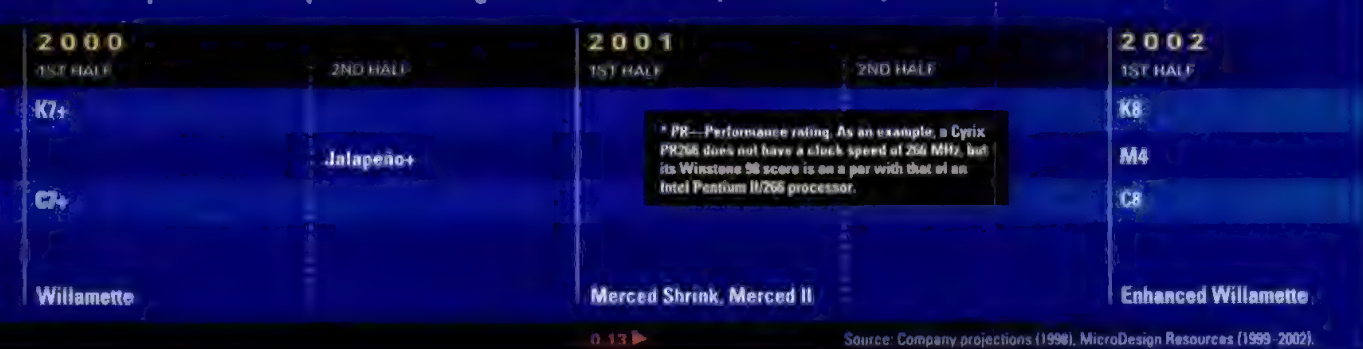
Yet another approach will be eliminating the processor bus entirely, as Cyrix has done in the MediaGX, by integrating part of the system logic chip set into the processor. Such a device would have PCI and DRAM interfaces rather than a conventional bus interface.

The device might integrate a graphics controller on-chip, like the MediaGX, or it could include an AGP connection. The DRAM interface could support DDR (double data rate) SDRAM or Direct Rambus, either of which will provide more memory bandwidth than a 100-MHz Socket 7 or a Slot 1 bus can support. This approach could allow Intel's competitors to reach higher speeds without having to use a new bus architecture.

Throughout the history of the personal computer, advances in microprocessors have been the driving force behind its evolution. And that's not likely to change as the new millennium dawns.

In 2001...
Advances in
Microprocessors
make even \$700
PCs faster and
more powerful
than 1998's top-
of-the-line
systems.

for PCs will splinter to an unprecedented degree in instruction sets, bus interfaces, and cache architectures:



Network Computers

The behind-the-scenes network computer could become part of everyday life, as well as a means of distributed computing.

By Linda and Erick Von Schweber

NETWORK COMPUTERS WILL BE EVERYWHERE in the coming years, but you may be hard pressed to recognize them. Although some will look like today's laptops and desktops, most will be hidden within devices such as TVs, telephones, and refrigerators.

To understand NCs and where they're likely to be in three years, you first have to accept network computing as a new architectural paradigm for deploying applications. In the previous generation of computing, before mainframe computers were routinely being compared to Jurassic lizards, users engaged dumb terminals to converse with a central processing unit, where data was consolidated and processing was executed. Today, networked PCs provide each user local storage and processing, with a preponderance of data remaining on the mainframe. This enables the graphical user interface, file, device sharing, and client/server computing.

Network computing goes a step further by distributing data, programs, and computing power across many nodes on the corporate intranet or the Internet. A distributed architecture is made possible by such networking software as TCP/IP; interprogram communication such as CORBA and IIOP; mobile code such as Java and data representation, and retrieval such as HTML and SQL. In the scheme of network computing, the user needs an appropriate access device to browse the information and to invoke the functionality available on the network.

Whereas a PC can be configured to act as a client in a network computing environment, an NC should be an embodiment of the best practices for deploying distributed applications—including compliance with standards, low

cost, and ease of administration.

A group of companies, including IBM, Netscape, Oracle's subsidiary Network Computer Inc., and Sun have worked together on this embodiment. This has led to the first wave of NCs, which look to many PC users like dumbed-down PCs with a network interface card but without a Pentium processor, hard disk, or much opportunity for expansion. To the user of a text-only 3270 terminal, however, they look mighty fine, sporting a Web browser and the ability to run personal and business productivity applications. They look like a good night's sleep to systems administrators, hoping to be freed of diverse maintenance hassles and perpetual upgrades.

As legacy systems become integrated into distributed *n*-tier architectures, NCs become viable candidates to replace old terminals. Over the next three years, the NC may also be a PC replacement option for some classes of users and for data entry and forms processing applications. NCs for these markets will continue to grow more powerful,

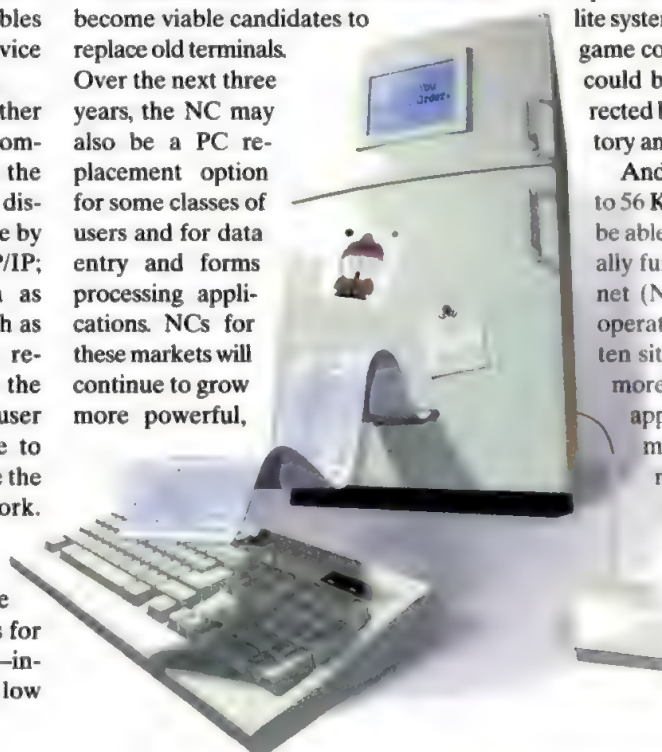
In 2001...
NCs grow more powerful, gaining USB ports, faster processors, and support for MPEG video.

gaining USB ports, faster processors, and MPEG video support. But they will continually lag behind the more open and modular PCs in support of the latest and greatest processors, 3-D graphics, and browsers. NCs are not likely to displace PCs as the power user's choice interface to the networked enterprise.

This may not be true for the home, where PCs have reached an estimated 45 percent penetration. This defines a market opportunity that NCs will attack with a vengeance—not with the desktop NCs now offered to the corporate world, but with embedded NCs invisible to the consumer and in many cases nearly free. NCs will be found in home telephone handsets, offering easy utilization of custom calling services as well as video mail and videoconferencing.

TV will get the NC treatment, too. NEC is preparing to embed network computers in some of its TV offerings. Scientific Atlanta is preparing a next-generation set-top box with an internal NC. DSS satellite systems will have NCs, as will home game consoles. Even the refrigerator could become an NC, providing directed browsing of recipes and inventory and linked to food retailers.

And although analog users limited to 56 Kbps (most home users) won't be able to reap its benefits, the federally funded Next Generation Internet (NGI) is expected to have an operational test network of at least ten sites across the U.S. running at more than 1 Gbps by 2001. One application strategy involves "remote rendering," in which a remote supercomputer somewhere on the network renders a 3-D scene and sends the images in real time to a local browser at 30 fps. At that point, the network really does become the computer.



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The TV PC

Merging the television and the personal computer will take some compromises, both in technology and standards.

By Jeff Mace and Rob Clidden

IN JUST A FEW YEARS, SET-top media computing devices will be far more powerful than any PC available today. These \$300 media computers will result from a multi-industry alignment of forces from digital broadcasting, consumer media computing, video games, and the broadcast Web. And they are going to have a big influence on the PC industry as we know it.

The question is not really if you'll get one of these media computers but how many you'll end up with and whether they'll constitute a single media-charged home PC or a collection of special-purpose boxes for games, cable, and Web browsing. Either way, the guts of each of these boxes will be very similar—gobs of low-cost media-processing power that the world's semiconductor fabrication plants will be delivering over the next 18 months.

At the center of this TV/PC convergence, expect to see a multimedia-charged consumer version of Microsoft Windows CE, likely to debut early next year. Game players are already tracking sightings of Katana, a next-generation Windows CE and DirectX video game console from Sega. Based on a Hitachi CPU and NEC's Power VR graphics chip, the new system is expected to hit store shelves in the spring of 1999.

In addition, broadcasting industries are following the announcements, made at the 1997 Winter Consumer Electronics Show, of Tele-Communications' (TCI) deals with Sun Microsystems for Java and with Microsoft for Windows CE for a new generation of Windows CE and Java set-top boxes. The announcement was for a *minimum* of 5 million units, but bear in mind that this figure comes from the same folks who wowed us a few years back with tales of interactive TV.

In 2001...
A single
media-charged
box provides
gobs of low-
cost processing
power.



Time for a reality check. The market space between computers and televisions has long been a killing field for bold product ideas. Even after the much ballyhooed Web TV was bought by Microsoft for an eye-popping \$425 million, it still has only approximately 300,000 subscribers. And the first generation of DVD players has been a dud in the retail space. The only long-term convergence survivors have been those curious hybrids of computer and TV: video game consoles.

Behind the scenes is a continuing bitter trench war over standards, control of broadcast bandwidth, business models, and industry rivalries. Couch-potato technophiles, take note: This will be a battle royal for the living room, and the weapons of choice will be price/performance breakthroughs in consumer media computing.

Probably the largest single unresolved fight remains over progressive scan (used by all computer monitors to display im-

ages) versus interlace (used by TV sets), and how high a resolution is high enough. These are three issues rolled into one.

First, what resolution is best for broadcasting signals? Incumbents with the most market power generally favor the higher, bandwidth-intensive resolutions. Second, what resolution should the moni-

tors use for displaying signals? TV manufacturers see a once-in-a-lifetime chance to move to high resolution. Some networks are leaning towards broadcasting in the high-resolution 1,080i line-interlaced HDTV-video transmission resolution, though some say it makes more sense to broadcast several-lower resolution channels.

Third and final, can decoders afford to decode all resolutions? A Pentium/200 can barely decode a single NTSC signal, much less handle the quadrupled resolution of HDTV (high-definition television). But new chips, designed for media processing will likely handle HDTV resolutions for a fraction of the cost of a Pentium chip. An effort by Compaq, Intel, and Microsoft last spring to require a lower resolution (a maximum of 720 lines), HD0 (high-definition television level 0, a specification set for HDTV proposed by PC companies) met great resistance from terrestrial broadcasters but may be supported by the TCI box.

Also unresolved are the basic standards for data broadcasting. Undoubtedly, Web standards will prevail here, but adapting Web standards to a pure broadcast environment is proving trickier than originally anticipated.

So what should you buy—and when? Expect little or nothing of interest to ship in 1998. Even the most stalwart of the HDTV crowd are projecting fewer than 100,000 units to ship in 1998, all in the cost-is-no-object range of \$3,000 and up. The first year of products of interest to consumers will be 1999, probably toward the holiday season.

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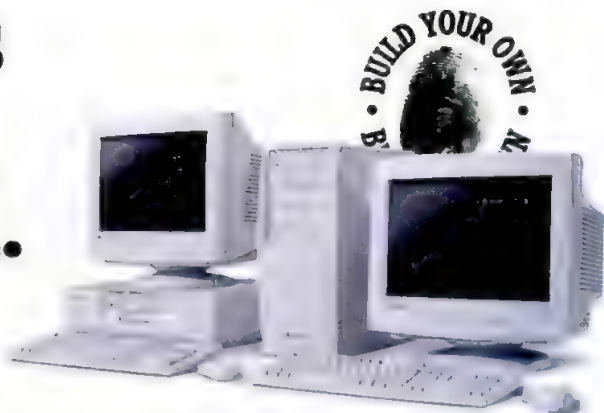


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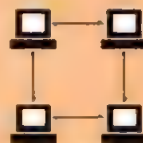


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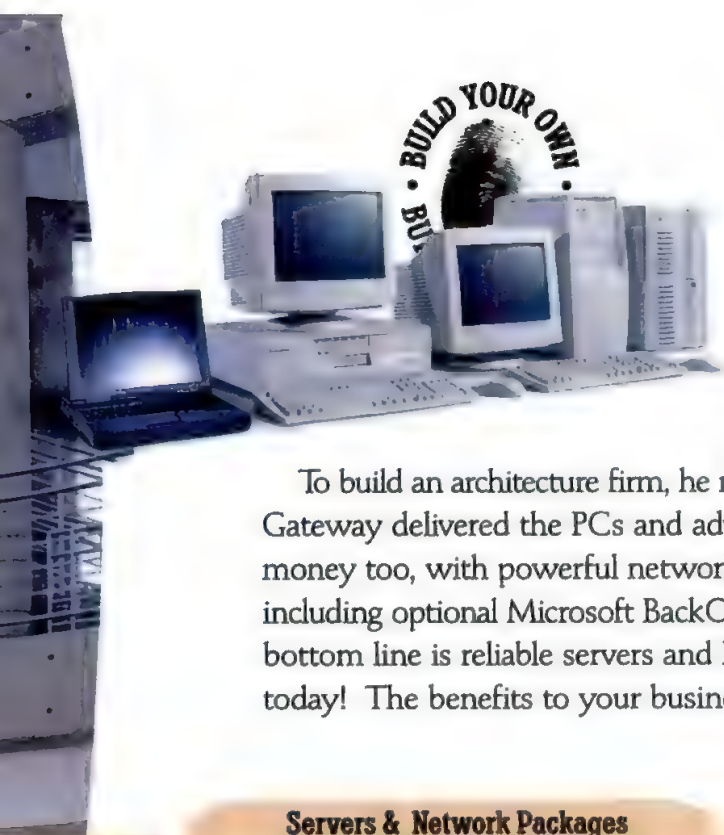
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Digital Imaging

Advances in digital video creation and editing will improve quality and affordability, but much will depend on connection speed.

By Jan Ozer

DIGITAL VIDEO HAS ALWAYS BEEN HAMPED by its reputation for being too difficult to produce and for producing output that compares unfavorably with television. But by 2001, digital video on most desktop PCs will exceed television in quality, and video-editing software will be as easy to use as today's entry-level desktop publishing programs.

And, in just a few years, the average entry-level system will be powerful enough to play back MPEG-2 video, as long as the video is played from either a DVD-ROM, CD-ROM, or hard disk.

Two factors dictate video quality: the processing power of the decoding station and the delivery medium. Most corporate training departments will have fast, dedicated connections capable of serving multiple 10-Mbps MPEG-2 streams. The general corporate desktop, connected via a 100-Mbps LAN, may be MPEG-2-capable, but the company won't spare the bandwidth for MPEG-2.

Most corporations will opt for proprietary schemes, such as RealVideo or NetShow, running at 200 to 300 Kbps. By 2001, MPEG-1 quality should be provided at these data rates, more than sufficient for most training and corporate communications. But most homes will be connected to the Internet via analog modems running at 56 Kbps or slower, so the current streaming solutions will still be around. Most sites will use scalable streams that deliver excellent quality to higher bandwidth customers, with lower quality available for slower connections.

Significant changes are also coming in video creation in the next three years. Prices for DV cam-

corders that deliver near-broadcast quality should drop to about \$1,000. And many PCs will ship with 1394 or USB ports, capable of downloading video from the cameras and eliminating the need for a capture card.

Output to MPEG-2 should cost under \$200, compared with today's prices of \$15,000 and higher.

Software, too, will change dramatically. To date, most video-editing programs have focused on serving only the high end, with such features as 2-D and 3-D motion paths, distortion, image warping, and gamma correction. Meanwhile, casual users are quickly discouraged by nonintuitive, timeline-based interfaces. But that will change when consumer-level video-editing programs provide templates for common corporate and consumer events. Each occasion will have a storyboard defining which shots to take and how best to film them.

When the time comes to produce the movie, the program will ask questions about the target audience and will automatically render in the proper format. If you are producing for CD-ROM, the software

might automatically encode in MPEG-1 format, RealVideo, or NetShow for the Internet. If Internet distribution is the target, the program will create the required HTML code and any required token files, a feature now apparent in streaming video encoders. The program also will create multiple streams in one compact file, letting the file serve a range of bandwidths from dial-up 28.8 Kbps, to ISDN, to T1 rates.

These programs will have all the power of today's video editors, and their interfaces will hide the complexity from non-

technical users while providing expert advice on video aesthetics. Most will have expert modes for advanced users desiring tweak-level editing access, however.

Fortunately, we won't have to wait until 2001 to start benefiting from these features. Avid Technology introduced the concept of templates with

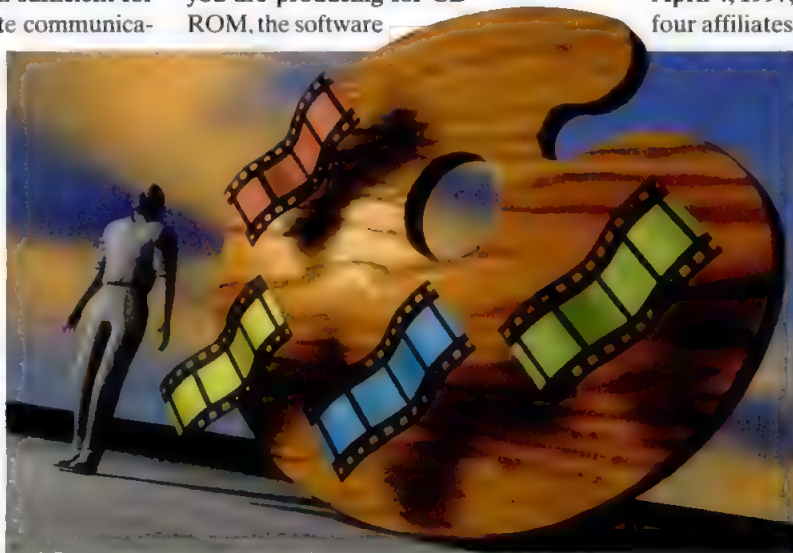
its Mac-based Avid Cinema in 1996 and promises to port the same features to a more widespread platform by midyear. MGI Software Corp.'s VideoWave automatically configures many capture and encoding settings according to intended output settings. And video-editing market leader Adobe Systems is set to introduce a program this year with promised functionality of Adobe Premiere in a more consumer-friendly interface.

No look at digital video can be complete without mentioning digital TV. On April 4, 1997, the FCC ruled that the top four affiliates in the top ten markets must

be broadcasting digitally by May 1, 1999, with markets 11 through 30 online by November 1, 1999. The FCC also set 2006 as the target end-date for NTSC service.

With multiple digital TV formats approved by the FCC, no one knows whether the aspect ratio will be the familiar 4:3 or the wider, more movielike 16:9, or whether scan lines will stay at 720 or bounce up to HDTV's higher resolution of 1,080.

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3-D Computing

Advanced instruction sets, memory, and chip set acceleration
will make computer images more lifelike than ever.

By Jan Ozer

THE PC OF TOMORROW WILL FEATURE 3-D graphics that equal or exceed today's arcade performance. Not only will the graphics power come built into the motherboard, the CPUs will have expanded instruction sets to accelerate the geometry phase of 3-D rendering.

These capabilities, which will suffice for most corporate and consumer applications, will also let the 3-D game market continue to flourish. Once arcade performance has been achieved, 3-D hardware makers will strive for an even greater immersive experience, matching, for example, the photo-realistic appearance of the graphics in the movie *Toy Story*. In addition, professional 3-D graphics accelerators serving CAD, animation creation, and similar markets will also continue as a viable segment.

The sub-\$1,000 PC market will explode. In particular, Cyrix Corp.'s MediaGL, with on-board graphics and audio, eliminates both the graphics chip set and dedicated graphics memory, removing at least \$30 in cost from the base computer, a significant number in the sub-\$1,000 realm.

At the same time, increased 3-D rendering performance largely shifted the 3-D performance bottleneck from graphics chip to host CPU, making 3-D geometry performance a key battleground in processor comparisons. In 1999, Intel will introduce 70 new MMX instructions, code-named Katmai, largely to enhance 3-D performance across its processor line. AMD claims that it will ship the K6-3D, with 24 3-D instructions supported by Microsoft DirectX, by mid-1998.

Intel's announcement of the I-740 completes the picture. The new 2-D/3-D part comes with

a bevy of buzzwords, including Parallel Data Processing (PDP), Precise-Pixel Interpolation (PPI), and Direct Memory Execution (DME). These processes translate into fast, high-quality 3-D performance and also provide Intel with graphics functions that can be embedded into the host CPU or Accelerated Graphics Port (AGP) chip set, producing the same cost saving as Cyrix's MediaGL.

The only remaining barrier with the current AGP architecture is that embedded graphics capabilities cannot be upgraded by a board

in the AGP slot, making a limit too inflexible for many computer manufacturers. Remedying this in future AGP generations sets the stage for 2-D/3-D graphics on the motherboard, initially connected via the AGP bus but ultimately embedded into the host CPU or AGP chip set.

By 2001, the base 3-D graphics capabilities of all entry-level computers in both geometry (host processor) and rendering (3-D graphics chip) capabilities will far exceed that available on the PC platform today, and upgrades will bring even higher performance levels. The biggest unanswered question is whether there will be any compelling business or nongame consumer applications that take advantage of

these capabilities.

Virtually all serious game play will occur on AGP systems capable of producing real-time, photo-realistic performance similar to that seen in animated movies. This means eliminating the jaggies, blocks, and the unnaturally flat textures characteristic of all 3-D games, and it will require a significant increase in both rendering performance and visual quality.

Part of the performance boost will come from new 3-D instruction sets in the host CPU, while the 3-D chip sets

themselves will accelerate by at least four times today's level, as dictated by Moore's Law of doubling performance every 18 months. Additional boosts will come from new memory types, including double data rate (DDR) synchronous DRAM, which will double memory throughput, or Rambus memory.

Decreasing memory prices will enable most 3-D

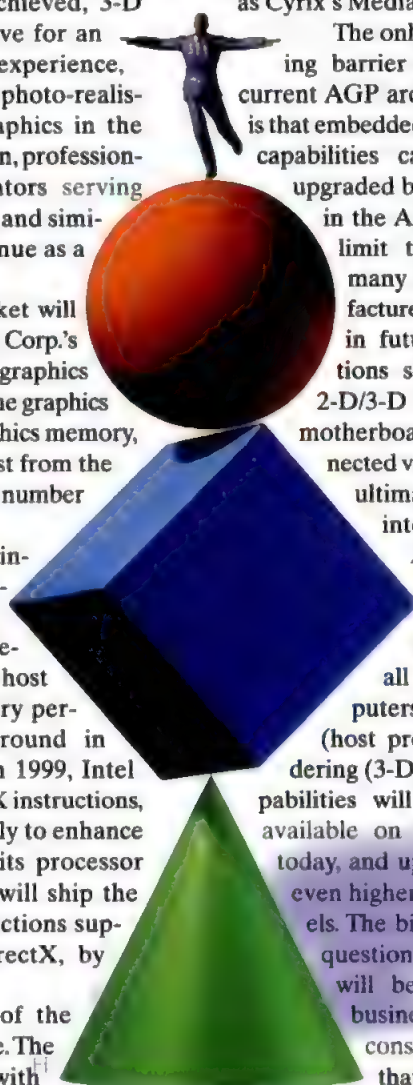
accelerator boards to ship with at least 8MB of memory, with most configured with 16MB. Although AGP allows textures to be stored in main memory, on-board memory improves performance measurably, and upgrade market dynamics dictate that more memory is better.

On the quality front, dedicated 3-D processors will perform full-scene anti-aliasing, which will remove most jaggies from the rendered image. Standard features will include bump mapping, an advancement on texture mapping that produces more realistic surfaces such as brick walls complete with the appearance of cement grooves and rough textures. Most chips will have dedicated gates for particle system acceleration, which makes particle effects such as smoke, rain, and hair seem more realistic.

In general, the level of realism will improve dramatically, with football players looking more like football players, and blood and guts, unfortunately, looking more like blood and guts. As a result, computer games will become an even more immersive experience, with fewer visual cues that fantasy is, in fact, different from reality.

In 2001...

Chip sets and microprocessors accelerate 3-D graphics to four times today's level of performance.



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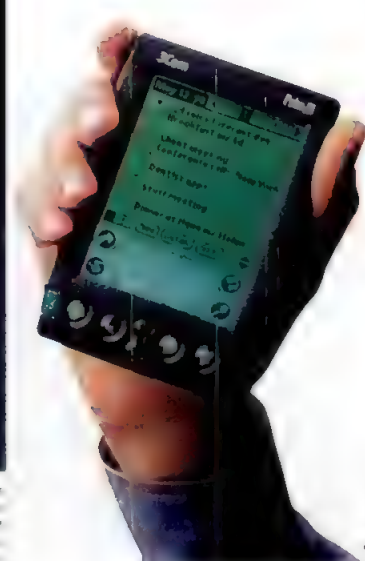
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Mainstream Graphics

Database and spreadsheet data will be liberated from a 2-D representation to 3-D charts that can be manipulated and viewed at all angles.

By Jeff Mace

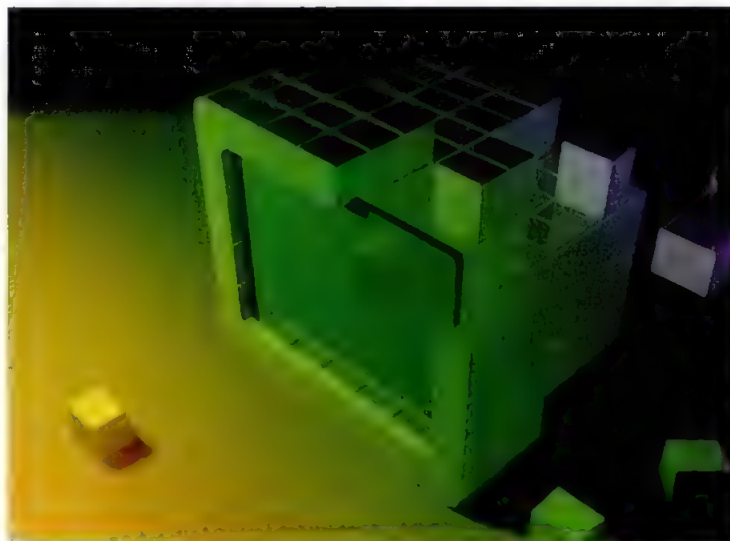
ONCE THE SOLE DOMINION of gamers, high-quality 3-D graphics are poised to make their way into the workplace in just a few years.

Foremost among new graphical business applications may be those using *data visualization*. Although this might sound like an overembellished term to describe someone working with numbers in spreadsheets all day, imagine numbers being object-oriented. This could be particularly useful when looking at stock market data, with data visualization making it easier to see the trends that the numbers represent.

NASA, for example, uses 3-D models of shuttle engines to visualize the changing temperatures at each thermal sensor site. More than 2K of numerical data per second is sent to terminals manned by space center technicians, who are charged with understanding an overwhelming stream of incoming data in real time. Since the Challenger disaster, 3-D models of the engines, acting as data receptacles, transform the information into the colors that represent changing temperatures. An engine can now be shut down before launch time if an O-ring causes the right aft section of an engine to run a bright red instead of a cool orange, for example.

Also, expect to see better graphics on the Web by next year through the evolving XML (Extensible Markup Language) and Dynamic HTML specifications, which should be fully integrated by 2000.

Graphics could also play an important



In 2001...
3-D software,
once limited
to gamers and
gear-heads,
finds its place
in business and
productivity
applications.

role in *data mining*—the pulling of numerical data out of information repositories such as databases and spreadsheets. Once-hidden information can often come to light when it is liberated from a flat 2-D representation to a 3-D chart that can be turned, manipulated, and viewed at any angle. Imagine also that you can do a real-time analysis of data that is being collected around the world, such as air traffic control at the world's busiest airports. You could spin a graphical representation of the globe, zoom in on a country, then a city, and see new traffic representations.

Before these new graphics applications are ready for inspection by the business user, some architectural restructuring at the foundation level under Windows is required. Today, a 3-D graphic is the prisoner of a window called a *direct draw surface*. 3-D objects can't simply exist outside it or be blended in with a typical 2-D application. In a game, for instance, the direct draw surface is usually the entire screen, which is fine for a standalone application such as DOOM. But business users need to check

their e-mail and run word processors while working with sophisticated graphics.

3-D needs to coexist with the 2-D desktop to become a true part of our daily life. That is partly what has kept 3-D a few steps behind all the hardware ready to accelerate it. But this is rapidly changing as the building blocks fall into place and address the problems.

Microsoft has been encouraging support for 3-D hardware through new multimedia extensions to the Windows OS, called DirectX Foundation. The evolution of these tools could enable the appearance of the applications of tomorrow. Now, OpenGL and Direct3D (which is part of DirectX) are the two 3-D APIs most applications may utilize if they require direct hardware support. Microsoft plans to redesign the Windows graphics device interface (GDI), which is the means for putting a display on your screen to meet the goal of merging 2-D and 3-D together.

Today's GDI is RGB-based and defines each red, green, and blue color channel on the desktop. 2-D and 3-D graphics can merge with an alpha channel, which acts as a translucent layer. This interface could also include the ability to perform 3-D transformations on Windows and to have windows that are partially transparent. Fahrenheit, the new joint initiative by Silicon Graphics and Microsoft, could provide for the eventual merging of OpenGL and Direct3D. Expect the delivery of the first set of tools in mid-1999, with a full release incorporated into DirectX in 2000.

As these pieces of the puzzle come together over the next few years, applications should become richer and fuller in their ability to help us work and play.

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Intel: Connected Car PCs and

By Cade Metz

The Intel Architecture Labs (IAL) has never been a traditional research operation. Whereas the labs at IBM, Microsoft, and MIT are more concerned with discovery than development, IAL engineers put development first.

Instead of focusing on singular technologies that may or may not reach the market in five to ten years, the Hillsboro, Oregon-based lab concentrates on platform architectures, data types, application software, and protocols that will expand the computer market in the near future.

"When you have an 80-plus percent market share," says Dave Ryan, IAL technology director, "you grow by growing the overall size of the market, not by taking market share from competitors." Since its 1991 inception, the IAL (developer.intel.com/ial)—in addition to spawning such Intel-specific products as ProShare video—has developed or helped develop many of today's ubiquitous PC technologies, including DVD, PCI, TAPI, USB, and Winsock2.

Ironically, Intel—the company most associated with core computer hardware—employs many IAL engineers as applications developers. "This is not to imply that Intel is going into the applications business," says David Behrmann, IAL marketing strategist. "We put effort into application development, because it teaches us what is needed to truly enhance real-world end-user experience." Though they may never be shrink-wrapped products bearing the Intel name, several applications designed by IAL may indeed shape the future of computing.

Begun by an Intel researcher in residence at the MIT Media Lab, an environment code-named Grand Canyon deals with time visualization and three-dimensional text. Grand Canyon is essentially a 3-D digital timeline that stretches not from left to right but straight out.

With a timeline of the 20th century's most significant headlines, for instance, you approach and pass each headline chronologically as if you were walking through a hallway of placards. This is an ideal way of constructing a virtual museum exhibit as well as examining your personal calendar. The rub is the creation of 3-D text, which is much more complicated and expensive than

the rendering of images. Such a project shows IAL technicians what is needed on the hardware side to handle future software.

Another IAL application now under development is Sedona, an attempt at the ultimate desktop. Grouping a file system, an e-mail client, a Web browser, and a news feed into a single GUI, Sedona eases the search for electronic information. When



The Intel Connected Car PC offers voice-activated input, roadway directions, real-time information for drivers, and a multimedia entertainment system for passengers.

perusing e-mail, you can ask Sedona to show you only action items or only e-commerce action items. When accessing the news feed, you can ask to see only stories of interest to you. Such classification and sorting is dynamic: The software learns what action items are or what your interests are as you supply it with examples. Sedona can also locate files, e-mails, Web pages, or news items relevant to the subject at hand without any active input. If you open a message or document, the desktop's unobtrusive scrolling window tells you what other messages or documents on your machine carry related information.

IAL software developers are even working with speech-enabled Internet gaming. Though most multiuser role-playing games, such as Diablo and Quake, let users communicate with each other in real time over the Internet, such communication is usually text-based. (You must quit playing for a moment to type and send your messages.) Using standard PC hardware and

the Ultimate Desktop

existing Internet telephone software, Intel researchers have solved this problem with a multipoint audio version of Diablo. As you play, you converse with distant competitors as if they are sitting next to you.

This is not to say that Intel's research and development efforts don't involve CPU architecture: This spring, the company's product divisions—entirely separate from IAL—brought 0.25-micron Pentium II technology to both the desktop and mobile markets, raised x86 clock speeds to 400 MHz, and introduced the 100-MHz system bus. Early summer will see the introduction of the first Slot 2 processor, a variation on the Pentium II that houses up to 2MB of full-speed secondary cache, compared with today's Pentium II's 512K of cache running at half the speed of the processor. This as-yet-unnamed processor—roughly the same length as a Slot 1 cartridge but twice as tall and outfitted with 50 percent more pins—is meant for high-end servers and workstations.

Though Intel will still continue to advance Pentium II clock speeds, its next major desktop CPU, Katmai, will not debut until the first half of 1999. This P6-based chip will incorporate 4X AGP

ized that improving and standardizing data types, communication protocols, and software platforms was just as important as enhancing the physical machine. "Historically," says Holland Wood, IAL senior broadband product engineer, "standard-based devices are the ones that become successful. They drive everything, from high volumes, to low pricing for customers, to actually making things work." Of course, such development requires the help of other major PC vendors and companies outside the industry.

Wood is now marketing the Universal ADSL (Asymmetric Digital Subscriber Line) Working Group, an IAL-driven consortium that should soon provide North American homes with high-bandwidth digital Internet access over existing copper phone lines. Expected to reach households by the end of the year, Universal ADSL modems can be installed without additional wiring and do not preclude standard telephone communication.

While enjoying always-on Internet access that's roughly 25 percent faster—at up to 1.5 Mbps downstream—than today's analog connections, users can still make and receive voice calls. ADSL modems running in Hillsboro allow for 80-Kbps RealAudio feeds, compared with standard feeds of 20 Kbps to 30 Kbps over analog, even as the user surfs the Web and downloads applications. Yet Intel is always one to hedge its bets: In the midst of Universal ADSL development, the IAL is also developing satellite and cable modems.

One of IAL's most fascinating projects is the Connected Car PC, a multifold automobile-based computing platform. Such a step may seem unusual for the world's leading processor manufacturer, but the automobile is not unfamiliar to Intel engineers. "Intel has been in the automotive business since we jointly developed engine controllers with Ford in the early eighties," says Patrick Johnson, the platform's marketing director.

The platform provides two distinct computing environments—one for the driver and the other for the passenger. Via simple data entry devices and voice commands, Connected Car PC gives the driver dynamic roadway directions, traffic reports, weather forecasts, commuting information, entertainment information, and roadway assistance technology. For passengers, the platform provides PC games, television feeds, DVD movies, Internet access, e-mail, faxing, and business applications. Intel has already licensed the technology to several automobile manufacturers, which can mold Connect Car PC to their liking and bring it to market within the next two to three years. "Once you have the platform," says Johnson, "there are so many other things you can do with it." IAL need look no further for a motto.



as well as so-called "new Katmai instructions"—70 additional SIMD instructions meant to enhance 3-D rendering and other floating-point operations. As with Pentium MMX technology, whose SIMD architecture handles integers rather than floating points, Katmai instructions will require new applications from third-party software vendors.

As Intel's product divisions improve processor architecture, IAL's role is to improve the architectures surrounding the processors. "In 1991," says Ryan, "with several new chips on the way, we knew the rest of the PC was incapable of keeping up. The labs were formed to enhance the hardware platform that housed the CPU." In developing new chip sets and motherboards over the years that followed, IAL engineers soon real-

Hand-Held Devices

The need for wireless communication and handwriting recognition will grow as pocket computers continue to shrink.

By Carol Venezia

THE HAND-HELD DEVICES THAT YOU'LL be carrying around at the turn of the millennium may look like the ones in your coat pocket or briefcase today, but they won't act the same. Regardless of their operating systems, they'll use less power, cost less money, and include more features, including the ability to connect to other computers without wires.

For hand-held devices to become completely wireless information and communications receptacles with battery lives measured in weeks instead of hours, some of their major components will have to draw much less power than they do today. To achieve this, companies are working on integrated chips that produce a higher MIPS-per-watt ratio. The recently shipped StrongARM-1100 is a good example of an integrated PDA processor. Combining all the logic of a hand-held PC, it runs at 200 MHz and consumes about 200 milliwatts. Intel agreed in February with Advanced RISC Machines (ARM) to sell and enhance StrongARM processors, although the deal is contingent upon the U.S. Federal Trade Commission's pending approval of Intel's purchase of certain assets of Digital Equipment Corporation.

3Com-owned Palm Computing's Palm III, introduced in March as the successor to the \$300 PalmPilot, signals another direction for hand-held computing technology. The Palm III features an infrared transceiver that beams information between two similar devices. This is only a small step, however, toward a completely wireless platform. To connect to the Web, for instance, you'll need a wired modem that snaps onto the bottom of the unit or the Novatel Minstrel, a wireless modem

that clamps onto the back of the PalmPilot but more than doubles its size.

True wireless connectivity could prove more difficult to develop, given that the technology is still young. But as with integrated processors, developments are under way. Earlier this year, Qualcomm hooked up with 3Com to develop wireless solutions for the Palm platform based on code division multiple access (CDMA) digital wireless technology. And because CDMA integrates both data and voice communications, seeing people talking to their hand-held PCs in the future won't seem odd.

Reliable handwriting recognition is necessary to complete the hand-held computing puzzle, but that technology could take even longer than wireless to develop completely. Although the Apple Newton's handwriting recognition has been the butt of jokes from Doonsbury to the Simpsons, it still leads the pack. Unfortunately, Apple recently discontinued development of the Newton OS; but the vendor is committed to affordable mobile computing solutions and will begin to serve this market with Mac OS-based products in 1999.

Optical read-only memory (OROM) could give a boost to hand-held device storage. Ioptics plans to introduce an OROM card this summer, offering up to 128MB of storage capacity with no moving parts. Data is recorded on the card in 2-D images called data patches. Total access

time is 10 milliseconds, nearly equivalent to that of a typical hard disk and ten times as fast as a CD-ROM drive.

On Microsoft's Web site, there are two specifications for "ultraportable" devices: hand-held PCs and palm PCs—the types of devices you're likely to see in the coming years. The first palm PC on the market should be the Philips Nino, available in retail channels shortly after you read this. The Nino is a cosmetic dead ringer for the Pilot, but like other Windows CE devices, it runs

pocket versions of Microsoft applications. Like most hand-held devices today, the Nino will still be tethered to the desktop for some functions, and is unlikely to last for weeks on batteries. And if you add a modem, the battery life will be drained. These are all the shortcomings of present-day devices, which should be addressed in the next two to three years.

The newest hand-held contenders are Windows CE devices. Version 2.0 of Windows CE hit

the streets last fall and has been gaining momentum through developer support ever since. Note, however, that without developers, a platform can stagnate and eventually die. In the past year, the Pilot platform has gained a huge developer following and has benefited greatly from the many applications created for it.

The market for hand-held PCs first sprang to life in 1990, with the introduction of the IBM-compatible Poqet PC Classic Model PQ-0164. This \$2,000 1.2-pound unit was about the size of a videocassette, ran MS-DOS 3.3 on an 8-MHz CPU, and used a nonbacklit CGA-compatible LCD panel. Best of all, the unit ran for two to three weeks on standard AA batteries. It wasn't until 1996 that the \$300 Pilot was introduced and eventually became the first device to enjoy widespread, mass-market acceptance.

For a young market, hand-helds have come a long way. And now that they have vast developer support, wildly successful products, and the attention of Intel and Microsoft, future developments are likely to progress at a rapid pace. The toys that James Bond totes around on the big screen that seem unbelievable now will soon seem as much like relics as 8-tracks do.

In 2001...The amount of time hand-held devices need between re-charges is measured in weeks instead of hours.



Top: The ultraportable Philips Nino will run Microsoft applications. Bottom: Ioptics will offer 128MB of storage.

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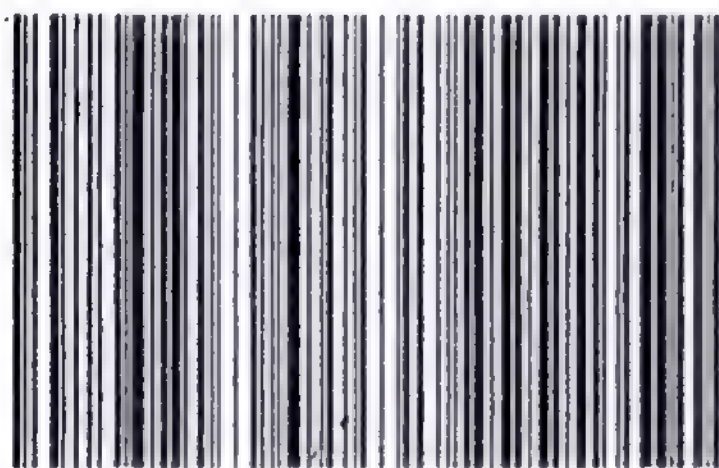
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IMATION

Home Automation

The PCs that now run most businesses will soon run many homes—controlling security, lighting, and energy use from a central location.

By Bruce Brown

YOU'RE AT WORK, MILES FROM HOME, when a window pops up on your PC screen, showing a repair person ringing your doorbell. You view the person via one-way video, converse with two-way audio, disarm the security system, unlock the door, turn on the lights, and then monitor the repair job via another camera inside your house.

That scenario is possible today with existing devices, though it's uncommon and is realized only by the wealthy and by technophiles. But, continued technology convergence will soon make widespread home automation a reality.

A 1997 survey by CEMA, the Consumer Electronics Manufacturers Association, found that consumers would purchase home automation systems for security (34 percent), convenience (22 percent), energy savings (21 percent), and entertainment (9 percent). The increasingly busy lifestyles of families, particularly those with home PCs, will make interfamilial communication another motivation to automate home living via PC, telephone, and appliance convergence. The ability to remind the kids to do their homework via an audio message sent from the car to an electronic pad on the refrigerator has great appeal.

The greatest issue of contention about the near future of home automation, other than creating market demand, is how the various devices will communicate. "No new wires" is the common banner call, though wires and cables won't go away. Certainly, if you're

building a new home or renovating an existing one, the smart move today is twofold: Prewire and use conduit. Prewire every room with 10/100-Mbps Ethernet cable, copper telephone wire, coaxial cable, and two-channel stereo wires. With present knowledge, pushing new cabling through conduit with room for additional cables is the best way to minimize the cost of future recabling.

Several current technologies use existing home wiring for computing, telephony, and appliance control. The X-10 standard sends one- and two-way signals via home AC wiring to control and monitor X-10 appliance-control modules—available for everything from lights to coffee pots. This spring, with the new CEBus Home Plug and Play standard backed by most major consumer electronics and PC industry companies, we'll see the first products for this AC wire protocol, which has greater

In 2001... A kid is reminded to do his homework via an audio message sent to an electronic pad on the refrigerator.

control and more reliability than X-10.

A number of companies now sell software to control X-10 modules, most notably Home Automated Living, whose HAL 2000 software will evolve this spring into a version that will control CEBus modules as well as X-10 units, including telephone access to the home automation system.

Novell spin-off Intelogis is about to release Passport, a system that allows PCs and printers to communicate via AC wiring. But Passport's high-frequency signal will not only wipe out X-10 and CEBus signals but will also send the encrypted signals to your neighbor's house.

Two recent efforts to stake a claim in home automation protocols are ShareWave and SWAP (Shared Wireless Access Protocol), both with backing by major industry concerns including Intel and Microsoft. ShareWave should be released by the time you read this. SWAP, promoted by the Home Radio Frequency Working Group, was announced in March as a specification for wireless home communications and control between PCs, appliances, and telephones. The first SWAP-compliant products are expected in late 1999. All new connectivity and networking technologies' survival will be judged by their ability to coexist with Ethernet, X-10/CEBus, and home telephony networks, or add value to them.

You need not wait for standards and protocol promoters to stop shaking their sticks, because the common theme of technologies for control and communications is network interoperability. You can have an Ethernet PC network with multiple X-10 and CEBus controllers, perhaps connected to PCs via USB with wired feeds between home entertainment devices via FireWire. The only reason not to start automating your home is if you aren't convinced you will be adding significant security, convenience, cost savings, or entertainment—or if you'd rather emulate Fred Flintstone than George Jetson. **PC**



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PCM060908

Displays

Computer monitors will get flatter and less

expensive even as they offer bigger and better views.

By Jamie M. Bsales

WE'VE SEEN THE FUTURE OF MONITORS, and it is flat. But alas, many of us will have to wait before flat-screen display technologies—liquid crystal display (LCD) and plasma, in particular—become affordable alternatives to today's cathode-ray tube (CRT) monitor. We will have a consolation prize in the meantime: bigger, better, and cheaper CRTs.

LCD advantages are compelling:

- **Size.** LCDs are small and lightweight and are hence easier to move and set up than CRTs, which are typically as deep as they are wide.
- **Power.** An LCD monitor draws less power than a comparable CRT.

- **Comfort.** In a CRT, electron beams sweep across the tube to repaint the screen. Although most users can set the *refresh rate* (the number of times per second the beams redraw the screen) so that the image appears stable, some users may still perceive flicker, which can lead to eye-strain and headaches. In an LCD screen, each pixel is either on or off, so there is no flicker. Also, CRT monitors give off small amounts of electrical emissions; LCD monitors give off none. Unfortunately, LCD technology's one

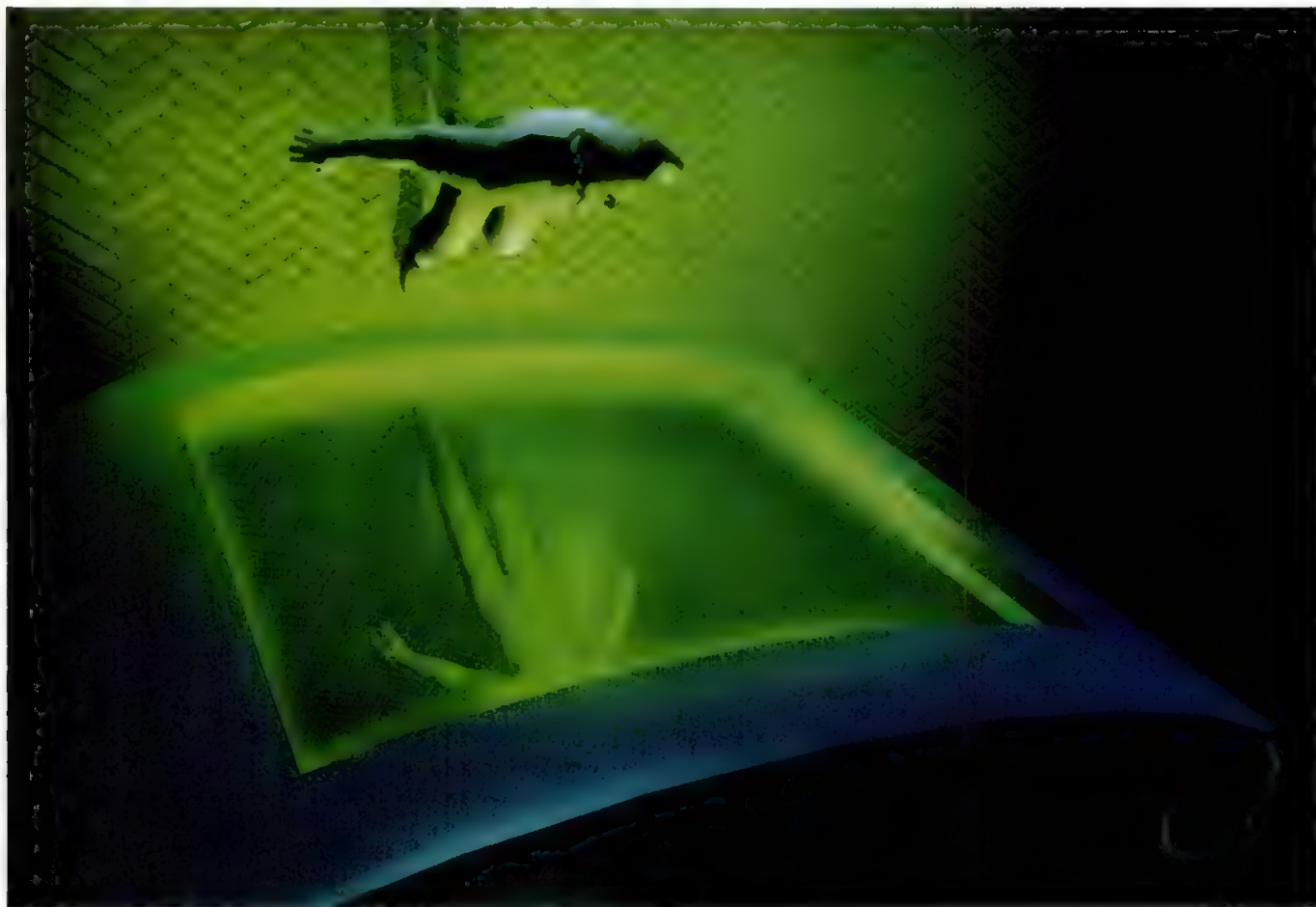
major drawback—cost—will persist into the next decade. A typical 14.5-inch LCD monitor (which delivers roughly the same screen size as a 15-inch CRT) costs about \$2,000, five or six times the price of a quality CRT monitor. And many users are perfectly happy with their CRTs, as CRT quality is almost universally high. Two years ago there was a lot to complain about regarding image quality on many models. Today, a poor

monitor is a rare exception. That explains why, despite the spate of LCD product announcements, industry analysts predict that sales for such models won't heat up for several years.

Less than 1 percent of the PC displays shipped in the U.S. this year will be LCDs, according to Stanford Resources, a San Jose-based market research firm.

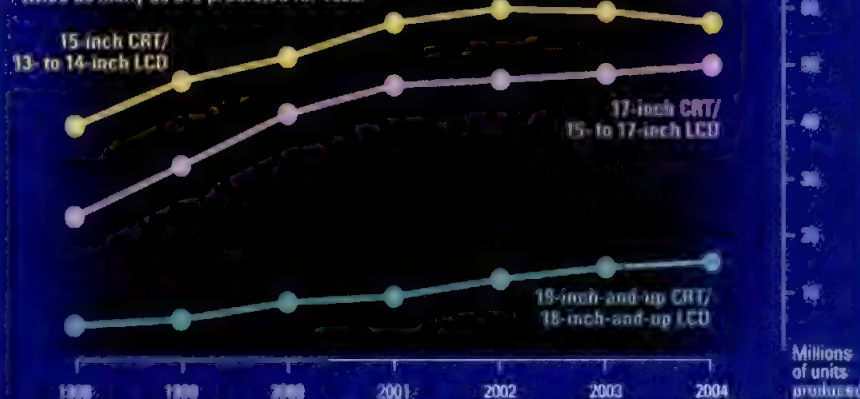
These units will be sold mostly into vertical markets such as brokerage and financial institutions and the medical

In 2001 ...
The average
price of
a desktop
LCD is \$879;
the average
CRT, \$213.



Size Breakdown of the Monitor Market

As we head into the next millennium, more 17- and 19-inch monitors will be manufactured. In 2004 vendors are expected to produce more than 50 million 17-inch displays, twice as many as are predicted for 1998.



Source: "Flat Panel Monitor Market Trends," Stanford Resources, 1998 (projections).

field, where the extra cost of LCDs can be justified. For example, the small size of an LCD panel means stockbrokers can have more screens in front of them—and execute more money-making deals. In hospitals, lightweight LCDs are replacing bulky CRTs on mobile medical equipment.

Stanford Resources estimates, however, that LCD monitors will account for 5 percent of monitor sales by 2000, as corporations deploy them in selected sites such as reception areas (where a clean, modern look enhances the corporate image). Stanford Resources expects that sales will hit double digits, reaching about 13 percent of the market share, in 2002. It also expects the average price of LCDs to drop from \$1,428 in 1998 to \$879 in 2001, but by contrast, the average CRT price will fall only from \$222 to \$213 by 2001.

LCD penetration will accelerate more quickly once makers succeed in lowering cost at a more aggressive pace. Fujitsu, Hitachi, Mitsubishi, Samsung, Sharp, and others are working on improved manufacturing methods to improve yields for the flat glass panels key to LCD monitors. Thus, the supply of LCD panels destined for the desktop should dramatically increase in the next two years.

Another advancement that could lower prices in the near term is improvement in dual supertwist nematic (DSTN) LCD panels. DSTN displays have always been less expensive than thin-film trans-

sistor LCDs but have also been inferior: DSTNs don't have the contrast and crispness of TFTs, and their slow response time means shimmering and ghosting, especially on moving images. But Sharp, the largest supplier of DSTN panels, recently introduced a panel that uses the company's High-Contrast Addressing (HCA) technology.

HCA panels offer contrast equivalent to that of TFTs and nearly as fast a response for video. A firm called Arithmos has developed a display engine for DSTN panels that improves the image further still. So for thrifter users, a DSTN display may be a good compromise. Arithmos expects a 15-inch DSTN LCD using its technology to appear this summer for around \$1,000.

With all this attention on the LCD as the probable replacement for the desktop CRT, another flat-screen technology could be on the rise. Plasma displays 40 inches and larger from Fujitsu, Mitsubishi, Panasonic, and Sony now compete with LCDs and large-screen CRTs for such uses as boardroom displays. Popular wisdom once dictated that plasma was best for 25-inch and larger displays, but we've already seen a prototype of a 20-inch plasma screen that is ideal for individual use. It should come to the market by 2000.

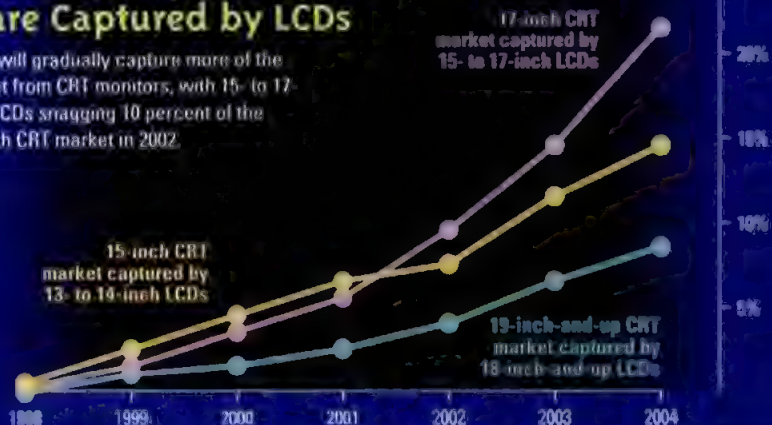
Even at just twice the price, flat-panel monitors will have a tough time supplanting CRTs, which still offer outstanding value. In 1995, a majority of PCs shipped with 14-inch monitors; in 1996, 15-inch models became affordable enough to become the desktop standard; and sales of 17-inch monitors took off in early 1997, as prices dipped below \$650. Luxury, 17-inch monitors should account for almost one-third of all models sold in the U.S. this year, and by the year 2000, the majority of sales should be for 17-inch units.

Moreover, 19-inch units should soon become affordable for many users: Prices have already fallen to \$800 to \$900, from \$1,100 just a year ago. Prices should continue to drop as more capacity comes from tube makers Hitachi, Philips, Sony, Toshiba, and others.

So for a handful of users, the flat-screen future will arrive this year. In the meantime, the rest of us will have to make do with larger, better, and more affordable CRTs. And that, as they say, ain't bad.

Percentage of CRT Market Share Captured by LCDs

LCDs will gradually capture more of the market from CRT monitors, with 15- to 17-inch LCDs snagging 10 percent of the 17-inch CRT market in 2002.



Source: "Flat Panel Monitor Market Trends," Stanford Resources, 1998 (projections).

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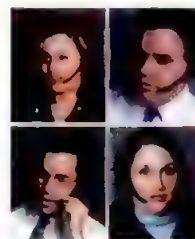
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QP5/233 SB-1 \$1049

Business lease: \$37/Mo.

- 233MHz Pentium® Processor with MMX™ Technology
- 2 Universal Serial Bus (USB) Ports / DMI 2.0
- 32MB EDO Memory / 512KB Pipelined Burst Cache
- 2 1GB EIDE Hard Drive / 3.5" 1.44MB Floppy Drive
- 64-bit 3D Graphics Card with 4MB SDRAM
- 15" Digital Monitor (11.8" viewable)
- Intel Pro 100 PCI Ethernet Adapter w/RJ-45
- 32X Max EIDE CD-ROM Drive
- Quantex Mid Tower Case
- 104-Key Keyboard with MS Mouse
- MS Windows 95/FREE Upgrade to MS Windows 98*
- 3-year limited warranty with 1-year On-Site Service**
- 24-hr./7-day Technical Support
- Q5entry Technology (including Intel LANDisk Client Manager V.3.1)
- Upgrade to Windows NT Workstation 4.0 for \$99

QP6/266 SB-1c (w/ Intel® Celeron® processor)...\$1149

QP6/266 SB-1 (w/ Pentium® II Processor)...\$1249

QP6/266 SB-2 \$1499

Business lease: \$53/Mo.

- 266MHz Pentium® II Processor
- 2 Universal Serial Bus (USB) Ports / DMI 2.0
- 32MB SDRAM Memory / 512KB Secondary Cache
- 4.3GB Ultra ATA HD / 3.5" 1.44MB Floppy Drive
- Intel® 740™ AGP Graphics with 8MB SDRAM
- Upgrade to 3D Labs Permedia 2 w/8MB SGRAM for \$49
- 17" Digital Monitor (15.8" viewable)
- Choice of Intel Pro 100 Ethernet Controller with Wake-On-LAN™ Technology or K56flex protocol Fax/Modem*
- 32X Max EIDE CD-ROM Drive
- Quantex ATX Mid Tower Case
- 104-Key Keyboard with MS IntelliMouse
- MS Windows 95/FREE Upgrade to MS Windows 98*
- MS Office 97 Small Business Edition
- 3-year limited warranty with 1-year On-Site Service**
- 24-hr./7-day Technical Support
- Q5entry Technology (including Intel LANDisk Client Manager V.3.1)
- Upgrade to Windows NT Workstation 4.0 for \$99

QP6/266 SB-2C (w/ Intel® Celeron® processor)...\$1399

QP6/300 SB-2 (w/ Pentium® II Processor)...\$1649

QP6/333 SB-2 (w/ Pentium® II Processor)...\$1749

QP6/350 SB-3 \$2099

Business lease: \$74/Mo.

- 350MHz Pentium® II Processor
- 2 Universal Serial Bus (USB) Ports / DMI 2.0
- 64MB SDRAM Memory / 512KB Secondary Cache
- 6.4GB Ultra ATA HD / 3.5" 1.44MB Floppy Drive
- Intel® 740™ AGP Graphics with 8MB SDRAM
- Upgrade to 3D Labs Permedia 2 w/8MB SGRAM for \$49
- 17" Digital Monitor w/NEC ChromaClear CRT (15.9" viewable, 25 dp, 1600x1200 max resolution)
- Choice of Intel Pro 100 Ethernet Controller with Wake-On-LAN™ Technology or K56flex protocol Fax/Modem*
- 32X Max EIDE CD-ROM Drive
- Quantex ATX Mid Tower Case
- 104-Key Keyboard with MS IntelliMouse
- MS Windows 95/FREE Upgrade to MS Windows 98*
- MS Office 97 Small Business Edition
- 3-year limited warranty with 1-year On-Site Service**
- 24-hr./7-day Technical Support
- Q5entry Technology (including Intel LANDisk Client Manager V.3.1)

QP6/300 SB-3 (w/ Pentium® II Processor)...\$1799

QP6/333 SB-3 (w/ Pentium® II Processor)...\$1899

QP6/400 SB-3 (w/ Pentium® II Processor)...\$2299

QP6/400 SB-4 \$2599

Business lease: \$91/Mo.

- 400MHz Pentium® II Processor
- 2 Universal Serial Bus (USB) Ports / DMI 2.0
- 64MB SDRAM Memory / 512KB Secondary Cache
- 8.4GB Ultra ATA HD / 3.5" 1.44MB Floppy Drive
- 3D Labs Permedia 2 AGP Graphics Card with 8MB SDRAM
- 19" Digital Monitor (18.1" viewable)
- Choice of Intel Pro 100 Ethernet Controller with Wake-On-LAN™ Technology or K56flex protocol Fax/Modem*
- 32X Max EIDE CD-ROM Drive
- Quantex ATX Mid Tower Case
- 104-Key Keyboard with MS IntelliMouse
- MS Windows 95/FREE Upgrade to MS Windows 98*
- MS Office 97 Small Business Edition
- 3-year limited warranty with 1-year On-Site Service**
- 24-hr./7-day Technical Support
- Q5entry Technology (including Intel LANDisk Client Manager V.3.1)
- Upgrade to 100MB Internal Zip Drive for \$79

QP6/300 SB-4 (w/ Pentium® II Processor)...\$2049

QP6/333 SB-4 (w/ Pentium® II Processor)...\$2199

QP6/350 SB-4 (w/ Pentium® II Processor)...\$2399

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Quantex H-1210 \$1949

Business lease: \$68/Mo.

- 233MHz Pentium® processor with MMX™ Technology
- Intel Mobile Module (I M M) Architecture
- 12.1" SVGA Active Matrix Display
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- PCMCIA K56flex protocol Fax/Modem*
- 24X Modular CD-ROM Drive
- PCI Bus with 128-bit graphics accelerator
- Integrated 16-bit Stereo Sound and Speakers
- Smart Lithium Ion Battery
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- Carrying Case
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- Add a PCMCIA NIC for only \$129
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- Add a 2nd Lithium Ion Battery for only \$129

H-1210 w/200MHz Pentium processor w/MS Office Technology...\$1879

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Business lease: \$114/Mo.

- 266MHz Pentium® II Processor
- Intel Mobile Module (I M M) Architecture
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- 128MB SDRAM (expandable to 144MB)
- 512KB Secondary Cache
- 4GB HD / 3.5" 1.44MB Modular Floppy Drive
- PCMCIA K56flex protocol Fax/Modem*
- 24X Modular CD-ROM Drive
- PCI Bus with 128-bit graphics accelerator
- Integrated 16-bit Stereo Sound and Speakers
- Smart Lithium Ion Battery
- Mini Docking Station
- USB and Fast IR Ports
- Integrated Personal Touchpad
- MS Windows 95 or Windows NT Workstation 4.0
- FREE Upgrade to MS Windows 98*
- MS Office 97 Small Business Edition
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- 3-year limited warranty on CPU and Main Memory
- 1-year parts and labor limited warranty on all other components
- Add a Deluxe Carrying Case for only \$39
- Add a PCMCIA NIC for only \$129

H-1411 w/233MHz Pentium II processor...\$3249

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QP6/333 SM-3x \$1999

Lease: \$70/Mo.

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- 64MB SDRAM Memory / 512KB Secondary Cache
- 6.4GB Ultra ATA HD / 3.5" 1.44MB Floppy Drive
- Intel® 740™ AGP Graphics with 8MB SDRAM
- 17" Digital Monitor w/NEC ChromaClear CRT (15.9" viewable, 25 dp, 1600x1200 max resolution)
- 100MB Internal Zip Drive with one cartridge
- K56flex protocol Fax/Modem* w/Voice Mail and Speakerphone
- 32X Max EIDE CD-ROM Drive
- Ensoniq 32-Bit Wavetable Sound Card
- Altec Lansing ACS-45 Speakers with subwoofer
- Quantex ATX Mid Tower Case
- 104-Key Keyboard with MS IntelliMouse
- MS Windows 95/FREE Upgrade to MS Windows 98*
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- Microsoft Office 97 Small Business Edition
- 3-year limited warranty with 1-year On-Site Service**
- QP6/266 SM-3x (w/ Pentium® II processor)...\$1799
- QP6/300 SM-3x (w/ Pentium® II processor)...\$1899
- QP6/350 SM-3x (w/ Pentium® II processor)...\$2199

QP6/400 SM-4x SE \$2999

Lease: \$105/Mo.

- 400MHz Pentium® II Processor
- 128MB SDRAM Memory / 512KB Secondary Cache
- 11.5GB Ultra ATA HD / 3.5" 1.44MB Floppy Drive
- Intel® 740™ AGP Graphics with 8MB SDRAM
- 19" Digital Monitor (18.1" viewable)
- 100MB Internal Zip Drive with one cartridge
- K56flex protocol Fax/Modem* w/Voice Mail and Speakerphone
- 2nd Generation DVD-ROM Drive w/Decorder Board
- Ensoniq 32-Bit Wavetable Sound Card
- Altec Lansing ACS-490 Speakers with subwoofer
- Quantex ATX Mid Tower Case
- 104-Key Keyboard with MS IntelliMouse
- MS Windows 95/FREE Upgrade to MS Windows 98*
- Power Multimedia Software Bundle
- Microsoft Office 97 Small Business Edition
- 3-year limited warranty with 1-year On-Site Service**
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Batteries

Whereas actual battery life will increase slowly, hardware and software workarounds will keep laptops going and going.

By Winn L. Rosch

A BREAKTHROUGH BATTERY THAT will let you work throughout an around-the-world flight on a single charge: That's the news everyone is waiting for. Take a number, because you'll be waiting way past 2001. No breakthrough in battery chemistry promises to stretch the three-hour average runtime that has tethered notebook PCs to their chargers for more than a decade.

But you may be able to make a coast-to-coast flight on a single charge early in the next century—not because of a new battery chemistry but better packaging, thanks to refinement of today's lithium cells combined with better power management.

The lack of change in notebook runtimes belies the advances made in battery chemistry. In the past decade, storage density (the amount of energy that fits into a given battery-size package) has approximately tripled—first doubling in the move from nickel-cadmium cells to nickel-metal

hydride, which also eliminated toxic cadmium from the battery pack. Lithium ion cells brought another 50 percent boost. But instead of taking advantage of these new chemistries to enhance battery runtime, manufacturers allotted the extra energy to feed the appetite of hungrier PCs, machines with huge active screens and power budgets in excess of 35 watts.

Those power demands don't bode well for the future. No exotic new chemistry promises dramatic storage-density increases. For example, yesterday's bright new technology, the zinc-air cell, doesn't suit notebook applications. Essentially an alkaline battery that breathes using oxygen from the air instead of internal reserves, zinc-air cells can pack more charge into less weight than any currently conceivable chemistry. AER Energy Resources has almost perfected the zinc-air design and offers commercial products based on it. But the company admits the

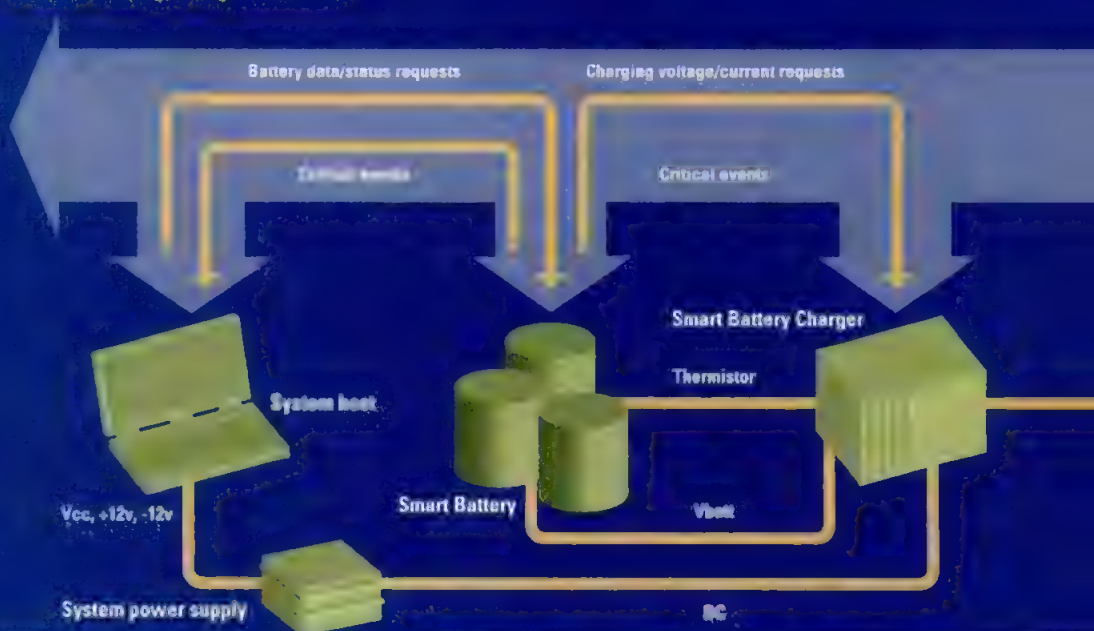
battery won't be in your next PC. High internal resistance means zinc-air batteries must be huge to satisfy current notebook PC needs: That means an auxiliary battery pack about the size of the PC itself.

Today's brightest new technology is a refinement of familiar lithium chemistry called the lithium solid-polymer cell. Conventional lithium ion cells require liquid electrolytes, but solid polymer cells integrate the electrolyte into a plastic separator between the anode and cathode of the cell. Because there's no liquid, the solid polymer cell does not require the chunky cylindrical cases of conventional batteries. Instead, the solid polymer cells can be formed into flat sheets or prismatic packages better able to fit the nooks and crannies of notebook computers.

Although the energy density of solid polymer cells is similar to that of ordinary lithium ion cells, PC manufacturers can shape them to fit the space available in a PC, squeezing more capacity into each machine. For example, simply by filling the empty space that would appear in the corners around a cylindrical cell, a solid polymer battery can fit in about 22 percent more chemistry and energy capacity. In addition, solid polymer batteries are environmentally friendly; lighter, because they have no metal shell; and safer, be-

Typical Smart Battery System

By definition, a *Smart Battery* is one that follows the Smart Battery Specification (SBS) developed by Duracell and Intel. This diagram shows one possible Smart Battery model, consisting of a battery, charger, and host (portable electronic equipment such as a notebook PC). The Smart Battery Charger periodically polls the Smart Battery for its charging characteristics, then lets the battery control its own charge cycle by adjusting the charger's output to match the battery's requirements. Optionally, the charger may prevent a fully charged Smart Battery from supplying power while the system is connected to AC power, thus prolonging battery life. The Smart Battery will also notify the Smart Battery charger when it detects a problem.



Source: Smart Battery Systems Implementers' Forum (www.sbs-forum.org)

cause they contain no flammable solvent.

But the biggest increases in battery life will come from improvements in electronics and control, specifically smarter batteries, and better power management systems. By definition, a *Smart Battery* is one that follows the Smart Battery Specification (SBS) developed by Duracell and Intel. Smart Batteries rely on conventional chemistries but require sophisticated electronics inside themselves and inside your PC, adding an estimated cost of \$10 to \$20 per battery pack. Sensing and signaling make up the intelligence of a Smart Battery, allowing the battery to describe its operating parameters and charge condition to its host computer.

Smart-battery technology can make an immediate and dramatic improvement in runtime. Simply by pushing back the time your PC takes to save its work automatically and shut down, smart batteries can boost runtime by 25 percent or more. Most PC makers select shut-down time by measuring battery voltage—an inaccurate guide that often forces PC makers to leave substantial reserves of as much as 40 percent of

capacity to ensure that you can safely shut down. Smart batteries sense their remaining charge and can accurately signal for a shutdown with 5 percent reserves or less, letting the system run longer on the same charge. Smart batteries also promote better charging, so you can pack more energy into your cells without overloading or overheating, which means batteries last longer before they need replacement.

Power management is the other technological key to extending battery runtimes. Instead of increasing the power available, power management eliminates waste. At its best, power management shuts off unused circuits inside your PC and slows down noncritical tasks. For optimal effect, it requires centralized control of all the power in a PC as well as the guidance provided by smart batteries.

The Advanced Configuration and Power Interface (ACPI), first announced in December 1996 by Intel, Microsoft, and Toshiba, standardizes the necessary control system and its interface. In effect, the standard gives an operating system control over the power usage of your PC.

ACPI requires both hardware and software support. Since Microsoft Windows 98 will be the first OS implementation, ACPI's power-saving ability remains to be proven.

If ACPI is even moderately effective, coast-to-coast runtimes may become possible. Take today's 2-hour average, add a 22 percent boost from solid polymer cells and another 25 percent from smart batteries (enough to push average runtime to 3 hours), and another 25 percent boost from ACPI will fill the working time in a transcontinental flight. More aggressive power management can increase runtime further—or let PC makers sap more power from your battery pack.

In 2001...
Laptops stay
powered up
for an entire
transconti-
nental flight,
thanks to
improved power
management.

SMBus (the System Management Bus)

The SMBus host is powered by the Smart Battery and can communicate with it. The SMBus host requests information from the battery and then uses that information in the system's power management scheme and provides the user with information

about the battery's state and capabilities. The Smart Battery will also notify the SMBus host when it detects a problem.

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Drive Size:	100 Megabytes	1,000 Megabytes	☐	☐	☐
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Cartridge Size:	100 MB	1,000 MB	☐	☐	☐
Cartridge Price:	10 Disks (1GB) = \$129	1 Disk (1GB) = \$39	☐	☐	☐
Seek Time:	29 ms*	12 ms*	☐	☐	☐

Product Name:	Jaz™	SparQ™	Jaz by Iomega	SparQ by SyQuest	Same
Size:	1 GB	1 GB	☐	☐	☐
Drive Price:	\$299	\$199	☐	☐	☐
Cartridge Price:	\$124	\$39	☐	☐	☐
3 Cartridge Price:	\$299	\$99	☐	☐	☐

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Storage

As floppy disks and CD-ROMs give way to higher-capacity devices, hard disks will stay their 40-year course.

By Jamie M. Bsates

CHOICES FOR BOTH FIXED AND REMOVABLE storage are about to become more varied. And though it will take several years for the dust to settle, two things are clear: The floppy disk drive as we know it will soon go away, and the magnetic hard disk is here to stay.

When Sony introduced the 3.5-inch floppy disk drive, it was a big improvement over the 5.25-inch unit that it eventually replaced. The 3.5-inch drive was faster and more capacious, and its rugged media fit easily in a shirt pocket. But the honeymoon ended several years ago, because the floppy disk's 1.44MB capacity proved useless for large multimedia files. So today, a battle is quietly waged among three competitors—the Iomega Zip Drive, the LS-120, and the Sony/Fujifilm HiFD—to become the next standard removable drive that ships in every PC.

To make it as the next standard, a drive will have to be inexpensive; the disks it uses will have to be inexpensive too, so users can give disks away and not

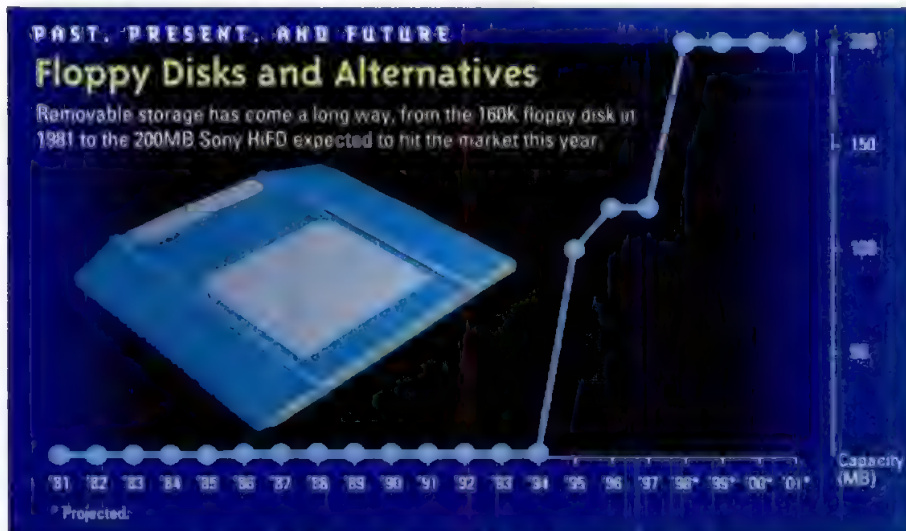
worry about the cost; and the disks will need to hold at least 100MB to be useful for transporting multimedia presentations or sharing digital photos. Also, the ideal drive will be backward-compatible with existing 3.5-inch floppies, so makers need not install two drives in new PCs.

A popular contender is the 100MB Zip Drive, which Iomega is offering in IDE versions to PC makers. More than 11 million Zip Drives have been sold, but the drive is not backward-compatible with the 3.5-inch floppy disk, making it less attractive to computer makers. Iomega points out, however, that 3.5-inch and 5.25-inch floppy disks coexisted for several years during the changeover.

The LS-120 drive, pioneered by Compaq, Imation, and Panasonic, looks much like a standard floppy disk drive, and it can read and write 3.5-inch floppy disks as well as its own 120MB 3.5-inch disks. The LS-120 has already enjoyed some success as a repackaged drive in new PCs from Compaq and others, and if not for Sony's newest drive, it may have become the new stan-

In 2001 ...

The average PC ships with a hard disk capable of storing more than 10 gigabytes of data.



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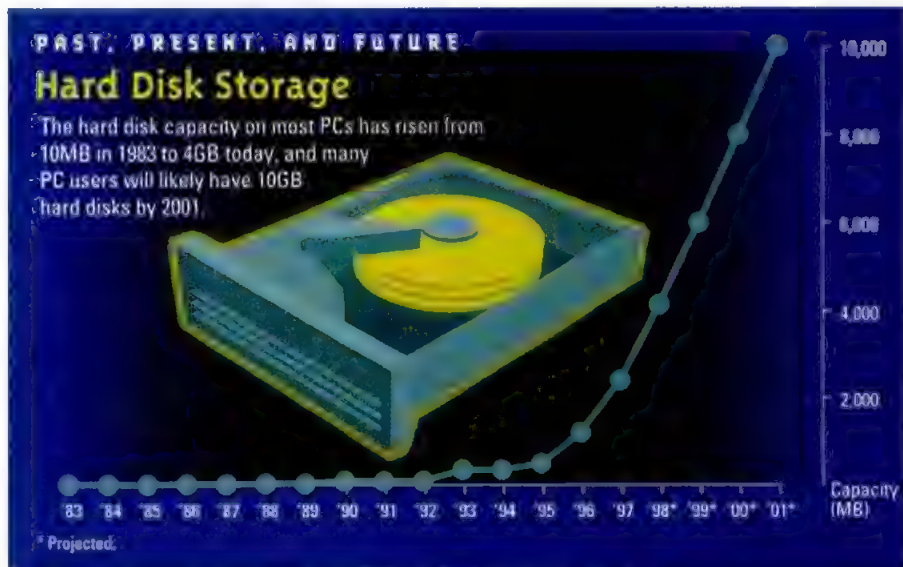
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dard. Expect future LS-120 generations to be more spacious, however.

Like the LS-120, Sony's HiFD, which begins testing this spring, is completely compatible with 3.5-inch floppy disks. But it holds 200MB on its two-sided 3.5-inch disks, and its transfer rate at a claimed 3.6 MBps tops the LS-120's 290-KBps rate. Also, pricing should be no more than 10 percent higher than the current price of a Zip unit, which has half the capacity.

Although the floppy disk drive is a lame duck, the Winchester magnetic hard disk, developed by IBM more than 40 years ago, will remain the medium of choice for fixed PC storage for the foreseeable future. Hard disks are reliable, fast, and economical. And continuing advancements will ensure that their capacity remains more than sufficient for most PC users well past 2000. A typical business PC now ships with a 4GB hard disk, up from 2.4GB last year and 1.2GB the year before that. IBM, Seagate, Quantum, and other hard-disk giants expect the sweet spot to move to around 10GB in 2000, though we expect it to be closer to 8GB.

Pushing the capacity growth is the widespread adoption of *magneto-resistive* (MR) heads for reading and writing data. MR heads are more sensitive than the older thin-film inductive heads still found in budget-priced drives. That sensitivity combined with lower flying heights will allow more data per square inch to be packed on the disk surface area.



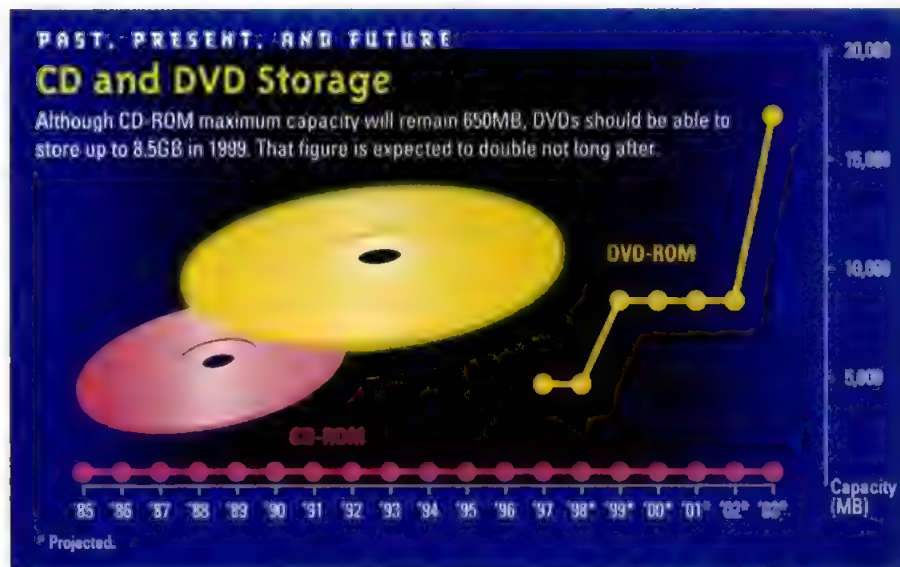
Thanks to other technologies, capacity should improve and MR should remain the medium to beat. For example, new *spin-valve heads* under development may deliver twice the areal density of today's best MR heads (now at 5 gigabits per square inch, easily enabling 20GB to 40GB disks). And Quinta, a subsidiary of Seagate, is working on Optically Assisted Winchester technology, which the company claims is able to deliver densities of 10Gb to 40Gb per square inch.

Other technologies will make inroads in mass storage, either as complements to or replacements for the hard disk. First will be read/write versions of DVD-ROM, which will all but supplant CD-ROM a year into the new millennium.

Two competing flavors of recordable DVD will ship this year: DVD-RAM, a 2.6GB standard favored by Panasonic, Toshiba, and others, and DVD+RW, a 3.0GB storage solution developed by Philips and Sony. Both read existing CD-ROM and DVD-ROM disks and could be used to replace those drives. Some companies plan capacity growth up to 17GB within the next seven years. Still, these optical technologies are no match for magnetic hard disks in performance or capacity.

Potential competitors with fixed magnetic disks expected this year are *Near Field Recording* (NFR) drives, based on proprietary technology developed at Stanford University and owned by newcomer TeraStor. NFR drives use a flying head like that of a hard disk, with a solid-immersion optical lens to record high areal densities on the magnetic surface of a plastic substrate. TeraStor claims a 20GB formatted capacity for its 5.25-inch disks—handily leapfrogging current hard disks.

So expect a typical PC in 2001 to have a removable media drive that can hold 200MB but also can read and write the current 3.5-inch floppy disks, a high-capacity removable drive to read DVDs and CDs as well as store gigabytes of information, and a 9GB to 10GB Winchester or possibly a Quinta or TeraStor fixed drive. (See *PC Magazine's* estimates and projections on the accompanying charts for the past, present, and future of storage.)



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Dot Pitch	0.28mm*	0.26mm	0.26mm	0.26mm	0.26mm	0.28mm
Max. Resolution	1600 x 1280	1600 x 1280	1600 x 1280	1600 x 1280	1280 x 1024	1280 x 1024
Optimum Res.	1,280 x 1,024 @89Hz	1,280 x 1,024 @88Hz	1,280 x 1,024 @88Hz	1,280 x 1,024 @79Hz	1,024 x 768 @87Hz	1,024 x 768 @87Hz

* Aperture grille pitch

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Audio

As many as seven speakers will envelop PC users
with 3-D audio and Dolby Digital surround sound.

By Jamie M. Bsates

MULTIMEDIA WILL RISE TO A NEW level in the next two years as the second wave of improvements emerges. The first revolution changed the once-mute PC with CD-ROM drives and sound cards; the next will use DVD drives and lifelike audio to make the PC a true multimedia machine.

DVD has a 4.7GB disk capacity, compared with the 650MB capacity of a CD-ROM. Although early DVD titles simply used the increased capacity to consolidate several CD titles, content developers recognize that newfound capacity could mean a new class of applications. Once DVD-ROM hits critical mass, there will be more audio- and video-rich edutainment titles, productivity applications, and interactive games. Market researchers Freeman Associates estimate that U.S. shipments of DVD-ROM drives should top 40 million units by 2000, compared with just 6 million this year.

In addition to better content, DVD-ROM drives may soon offer better speed. The current DVD drives can transfer data at 1,350 KBps—roughly equivalent to an 8X CD-ROM. The next generation of DVD drives, due this year, will reach 10X. But spinning the disks faster introduces wobble; and with the densely packed data on a DVD, read errors skyrocket, and the drive must spin down and reread tracks.

Enter Zen Research, which says it has a better way to increase DVD throughput. Zen's TrueX technology for optical disks employs a split laser beam that reads seven to ten tracks at a time. The drive's cache then has more data ready when the CPU requests it, and

throughput can approach a hard-disk speed of 24 MBps.

The audio side of the multimedia equation is equally promising. New audio standards will enable more lifelike 3-D PC sound than ever before. They include:

- **Dolby Digital** (also called AC-3). This system, also used in home theater setups, uses five channels to envelop the listener and adds sound depth with a subwoofer. Content developers will start releasing titles encoded with Dolby Digital audio late this year, and new sound cards and speakers from Altec Lansing, Cambridge Soundworks, Creative Labs, and others will enable this immersive sound.
- **Sound Blaster Live**. Expect the first Sound Blaster Live sound cards this year, with improved generations to follow. Creative Labs' Environmental Audio scheme can use up to seven speakers plus a subwoofer. Using the powerful new

audio chip set from its subsidiary E-mu Systems, Creative Labs aims to deliver sound reproduction that rivals real life through *environmental modeling*.

- **Aureal 3D** and **QSound**. Instead of using several speakers to create a 3-D listening environment, multimedia titles can be encoded with information that creates the illusion of 3-D sound through headphones or just two PC speakers. Aureal and QSound-encoded games are already available, and dozens of sound card and speaker vendors plan to include the circuitry that delivers the 3-D effects.

Three Microsoft APIs will help enable the enhancements. DirectSound and DirectSound3D will let developers mix

multiple audio streams and program surround channels independently in real time. DirectMusic will let developers replace redundantly looping music snippets with music that intelligently transforms its tempo and chords to match what's on the screen.

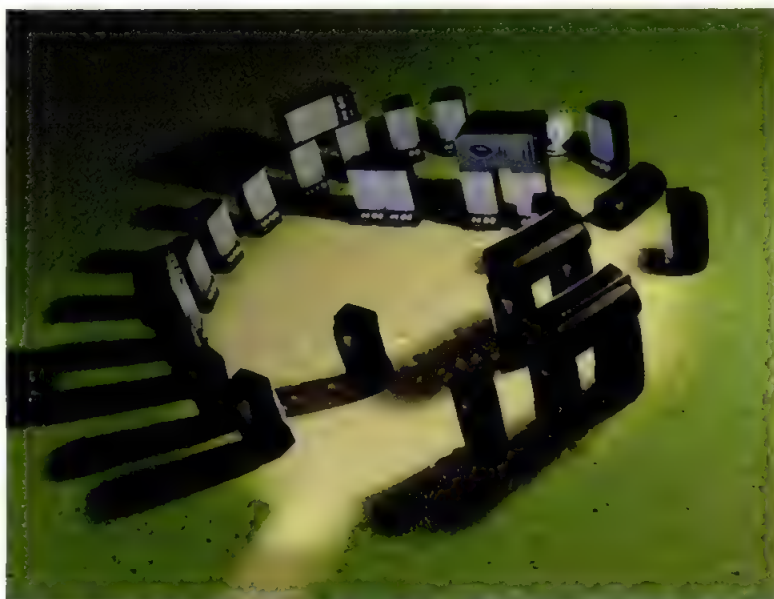
Such new functionality will require more bandwidth than the present ISA bus now used for sound cards can deliver. But the PCI bus can handle 3-D audio and lets sound chips on add-in cards handle functions

that, under ISA, had to be handed off to the CPU. Microsoft's PC98 specification requires PC makers to move to PCI audio

in order to merit the Windows logo, so expect most PCs to ditch ISA by 1999.

In a typical 2001 office, you'll find a PCI sound card with a three-piece speaker system attached (subwoofer and two satellites). Thanks to advanced 3-D modeling algorithms, the satellites will be able to deliver Dolby Digital surround sound that it currently takes five speakers to reproduce. A typical home audio environment will also have a PCI sound card, but it will feed five or seven speakers to deliver immersive sound.

In 2001 ...
U.S. shipments
of DVD-ROM
drives exceed
40 million units;
CD-ROM ship-
ments have
fallen to fewer
than 7 million.



DLP VS. LCD: A DIGITAL DIFFERENCE YOU CAN SEE AND FEEL.

By S. E. Easter



Digital Light Processing™ (DLP™) technology from

Texas Instruments is a revolutionary all-digital technology that enables lighter and smaller projectors. Unlike conventional LCD systems that contain large,

heavy optics, DLP technology allows a smaller, more compact optical system that delivers phenomenal visual impact.

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DLP technology has pioneered a new class of extremely bright ultraportables. A projector weighing under 10 pounds can now deliver over 600 lumens of digital light.

system. DLP technology is able to achieve higher levels of brightness through its all-digital design, producing more usable light than traditional LCD systems for brilliant, lifelike displays.

Another digital advantage is the DLP system's enhanced image quality. The unique digital image projected by a DLP system contains 256 grade levels for each of the primary colors, producing 16.7 million digitally correct color combinations. Projected images appear precise and film-like. And DLP technology's digital design creates a clearer, seamless image, unlike LCD technologies that suffer from the infamous "screen door" effect.

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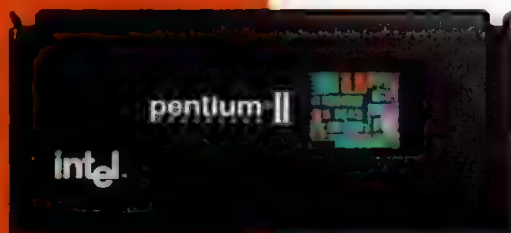
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IBM: Browser Brains and QBIC

By Cade Metz

Computer hardware's progress is often defined only in terms of clock speed and bandwidth. But if not for the continued improvements in data storage over the past 40 years, Moore's Law would be trivial and 56-Kbps modem speeds would be excessive.

The center of hard disk innovation is the Almaden Research

Center in San Jose, California, one of the seven IBM research labs in operation across the globe (www.research.ibm.com). Almaden (www.almaden.ibm.com) is home to about 600 researchers, each developing new ways to store data and handle it once it is stored. "We're about information," says Ashok Chandra, director of computer science at Almaden, "managing information, gathering it, saving it, searching through it, and distributing it in useful formats."

The world's first hard disk was developed in November 1956 in downtown San Jose, only a few miles from the current Almaden site. The RAMAC 305—a stack of 50 spinning platters, each 2 feet in diameter—stored a then-remarkable 5MB of data, the rough equivalent of 60,000 punch cards. Over the next four decades, IBM researchers have improved on this prototype nearly 2 million-fold. Almaden engineers last year set the standing world record for hard disk data-storage density, reaching 11.6 billion bits per square inch with their latest GMR (giant magnetoresistive) drive. The drive can store the equivalent of more than 725,000 typewritten pages in a space slightly larger than a thumbprint.

Almaden's Storage Systems & Technology division is advancing every facet of hard disk design, from the magnetic materials used in disks themselves, to the lubricants that coat the disks, to the heads that read the data, to the sliders that move the heads. GMR drives, however, cannot be improved in perpetuity. As GMR researchers approach the *superparamagnetic limit*—the data-storage density where temperature changes can cause random reversals in a bit's magnetization—other engineers are exploring alternative technologies, including holographic storage and molecular-scale devices.

Another Almaden division deals with types of data al-

ready stored. Continuing a project that began in Neil Gershenfeld's physics group at the MIT Media Lab, Tom Zimmerman of Almaden's Computer Science division is working with data sent not across computer systems but across the human body. His Personal Area Network (PAN) uses a small silicon card that sits in your back pocket and communicates with various people or machines by sending a low-frequency, low-power signal through your body. When you shake hands with someone, your cards could exchange addresses and phone numbers, for instance. You would only have to touch a telephone to give it your calling-card number or touch a car door to unlock it. An exercise machine at Almaden can accept a PAN signal and automatically begin a regime specific to you.

Dragutin Petkovic, also in the Computer Science division, has long been engaged with QBIC (Query By Image Content), a means of organizing

and searching a database of images using actual color, shape, and texture rather than just keywords. With a traditional image database, you must catalog each image using a written description, then

retrieve images by matching keywords within those descriptions. With QBIC, pronounced *cubic*, the cataloging is mathematical. "We index an image by examining individual pixels and extracting numerical color and layout information," says Petkovic. When searching a collection of stamps, for instance, you simply "show" the database an image whose color or texture resembles the stamp you're looking for.

Rob Barrett, an Almaden physicist cum computer scientist, is working on a *software intermediary* known as WBI (Web Browsing Intelligence). Similar to agents, intermediaries work in the background to "customize and enhance your environment," Barrett says. Sitting between your browser and the Web, WBI augments each page you visit and uses various mini-applications to facilitate the browsing process. Regardless of where you are on the Web, small *traffic lights* sit beside each hyperlink to indicate the availability of the servers you're about to visit. *Advisors*, terse annotations that pop up throughout a page, point to items in a predefined catalog (Yahoo! or a personal database, for example) that are relevant to the subject at hand. "In one sense," says Barrett, "WBI is a lens through which to view the Web."



IBM's Personal Area Network transmits data through the body's natural electrical conductivity.



Peripheral Connections

USB and IEEE 1394 standards could end years of hardware headaches,
connecting devices to the PC and to each other with simple plugs and cords.

By Nick Stam

MANY PERIPHERAL DEVICES OF THE future will be attached to your PC by one of two emerging standard connections: The IEEE 1394 (FireWire) Serial Bus and the Universal Serial Bus (USB).

Adding a peripheral to a PC can be an aggravating experience. Even sophisticated users can struggle to resolve IRQ and DMA conflicts or to properly install device drivers. The goal of USB and IEEE 1394 is to make device expansion a snap.

USB was conceived in 1993 by a team from Compaq, Digital, Intel, Microsoft, and NEC, with IBM and Northern Telecom joining soon after. A Dataquest study reports that 50 percent of all desktops and 20 percent of all notebooks shipped in 1997 included one or more USB ports, rising to nearly 100 percent and 80 percent, respectively, in 1998. By 1999, USB ports will be included in virtually all new desktop PCs and mainstream notebooks. About 500,000 USB devices shipped in 1997, with projections for 2001 at about 195 million.

Between the two USB ports included on most PCs, up to 127 devices can be attached. USB provides 12-Mbps connections for high-speed devices and 1.5-Mbps connections for low-speed devices. USB is a *tiered-star topology*, in which multiple layers of hubs can communicate with each other and the attached devices. USB can provide power for low-power devices and permits attachment of self-powered devices. Many attached devices require additional external downstream hub devices.

Like USB, the IEEE 1394 bus is a digital plug-and-play bus with a tiered-star topology. By contrast, 1394 is capable of peer-to-peer connections, doesn't require hubs, and delivers much higher data rates.

Three speeds for device connections are available today—100 Mbps, 200 Mbps, and 400 Mbps—and up to 63 devices of any of the speed grades can be attached to one bus. A maximum of 1,023 buses can be interconnected, and devices are hot-pluggable. Self-powered and bus-powered devices can also be attached to a 1394 bus.

IEEE 1394 was conceived in 1986 by Apple to simplify its computer cabling and provide a high-speed interface for real-time digital data. Apple originally dubbed the technology FireWire, which is still used interchangeably with IEEE 1394. The 1394 bus is not expected to penetrate the market noticeably until mid-1999: Large volumes of 1394-based peripheral products could be developed today, but since support chips are available from multiple sources, no PCs have 1394 receptacles, and OS support is missing. Few mainstream users can be expected to acquire PCI-to-1394 expansion cards unless they have specific needs, such as connecting a digital video camera.

Although one or more 1394 ports might be included in future PCs, NCs, NetPCs,

and even Windows terminals, the variety of networking devices, PC peripherals, and consumer AV devices that might house 1394 interfaces will be wide. Such devices include but are not limited to digital video and still cameras, digital VCRs, high-speed cable modems, satellite interfaces, LAN connections, PDAs, set-top boxes, DVD-

ROM drives, printers, scanners, video I/O cards, digital audio receivers, CD-ROM and DVD players, optical and removable disk drives, video-conferencing cameras, and digital TVs.

PC users should expect to see numerous 1394 ports materialize by 1999, as Intel builds 1394 support into its upcoming chip sets. Physical ports must be added to motherboards, and BIOS support must be de-

veloped. Windows 98 and NT5 will include bus driver support, though initially Microsoft will release only partial 1394 support for Windows 98. Additional support for storage devices will surface sometime later, as 1394 devices appear and Serial Bus Protocol (SBP-2) development stabilizes. SBP-2 allows SCSI commands and data to be transported over the 1394 serial bus. Neither USB nor 1394 technology is fully

baked, and few products have been introduced, although virtually all new desktop PCs and high-end notebooks now include USB ports. Still, users should expect both buses to become de-facto standards. With the abundance of device interfaces and buses in existence today, it's possible that 1394 and USB really will simplify our lives. **PC**

In 2001...
About 195
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are shipped
that can be
plugged into
a PC via a USB
connection.



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Operating Systems

Operating systems will get bigger, with 64-bit addressing, and operating systems will get smaller for hand-held devices, set-top boxes, and even stereos.

By Larry Seltzer

IN A FEW YEARS, WE WILL EXPERIENCE A rare event in computing—the death of a dominant operating-system architecture. The vast majority of users have personal computers running the old Microsoft Windows kernel—the one that runs Windows 95 and Windows 98 and is based on the Windows 3.x kernel. All of these are boot- ed from DOS, and they're all going away.

Why is this about to happen soon? The old Windows kernel has made sense up to now as a mainstream operating system, because the next-generation operating system, Windows NT, doesn't support inexpensive computers, has a limited range of device support, and lacks mobile computing features. Windows NT is finally on the verge of addressing all these concerns: The next consumer version of Windows after Windows 98 will be a version of Windows NT. This version won't displace either the workstation or the server versions of Windows NT. Instead, there will be even more members of the Windows family from Microsoft, all based on Windows NT.

The effects of shifting the mass of regular users to a Windows NT product are difficult to nail down. Certainly Windows will become a more stable platform as a result, but Microsoft has some hard work ahead of it in making Windows NT usable as a consumer operating system. It is safe to say that the user interface could change significantly between now and then. It is also safe to say that many of the worst techniques used by Windows programmers—such as requiring users to modify Config.sys and other system files—are either illegal or simply not problematic in Windows NT.

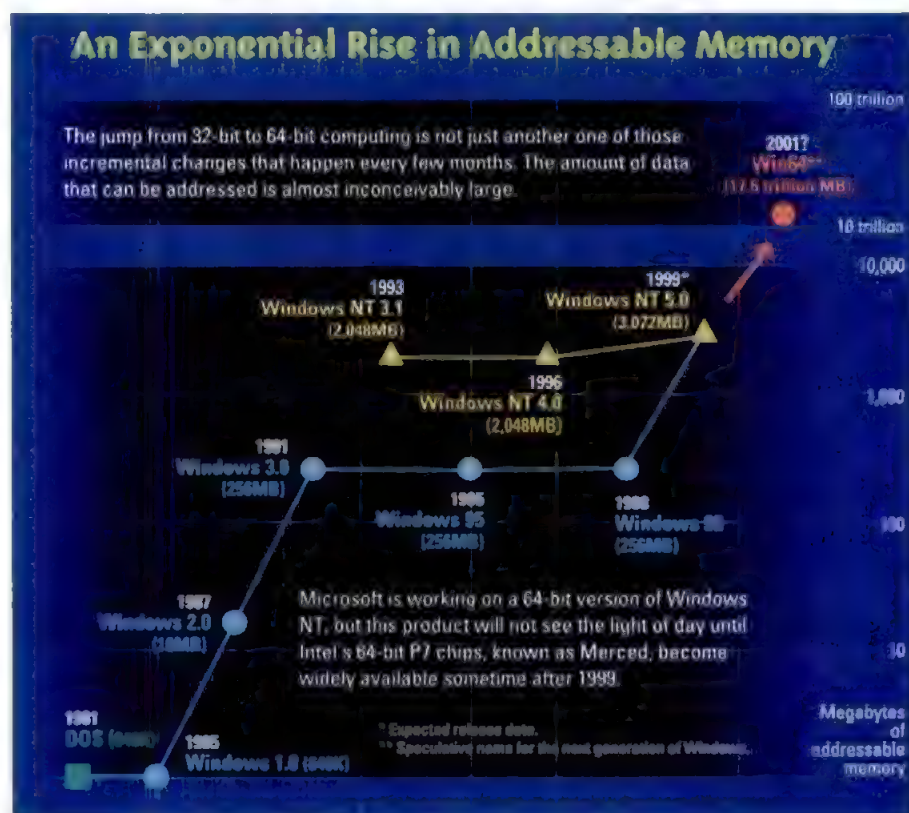
Around the same time the old Windows kernel goes away, a parallel hardware revolution will create the next era of computing—64-bit architectures. The jump from 32-bit to 64-bit computing is not just another one of those incremental

changes that happens every few months, such as a Moore's Law jump in processor speed; 64-bit address space is almost inconceivably large. The best way to conceive of the enormity of a 64-bit address space is to imagine the more than 4 billion bytes of space in a 32-bit address, and then add more than 4 billion bytes to that.

Once-impossible techniques and applications will be routine with 64-bit addressing. With a memory-mapped file system, for instance, programmers will not need to open, close, read from, or write to files anymore. They will simply get a data structure from the operating system that contains the data in the file. The operating system will move the bytes between disk and memory as necessary. There would be enough address space in a 64-bit system to make this possible. (For more details, see

the chart below, which compares the addressable memory of recent operating systems.) Another technical benefit of 64-bit computing will be the ability to use integers instead of floating-point numbers for many applications, such as processing financial data. This should speed up such processing and simplify programming.

This change will come not a moment too soon, as there are many applications for which 32-bit address space is insufficient. In fact, many RISC processors only allow 31-bit addressing, as the upper bit is used to separate a user from supervisor-level access to memory. Systems with a gigabyte or more of memory are not all that rare anymore, and it is certain that 2GB and 4GB systems will be out there in the next few years, managing large databases and modeling complex systems such as



the weather and the economy.

Microsoft is working on a 64-bit version of Windows NT, but this product will not see the light of day until Intel's 64-bit P7 chips, referred to as Merced, become widely available. Merced is not expected to be released until 1999, and its presence in the marketplace will become common over the few years following.

Even though Windows NT has run for years on 64-bit Alpha processor, it runs as a 32-bit operating system. Windows NT 5.0, due out in late 1998 or early 1999, contains some less ambitious tricks to expand the address space of programs. On x86 processors, Windows NT 5.0 is expected to allow for more efficient use of the 4GB address space, and on Alpha processors it will allow 64-bit addressing of memory but with little or no help from the operating system in managing that memory.

There are 64-bit versions of Unix already available for some architectures, such as Digital Unix for the Alpha processor. 64-bit versions for other architectures, such as Solaris for Sun Microsystems's UI-

traSparc, will be available long before a 64-bit version of Windows. The push for these products—as it largely will be with a 64-bit version of Windows—will be based on their greater scalability, performance, and power rather than on revolutions in programming.

Speaking of revolutions in programming, Java is also arguably an operating system of the future. Although Java is first and foremost a programming language, it is also a set of common system services available on all implementations and a target for developers. So developers can treat Java as an operating system as long as they are willing to restrict their programming to the Java language.

In a few years, Java could play a large role as a "glue" between different computers, especially different types of computers. Unfortunately, concerns about litigation and compatibility of future

versions of Java cloud this picture. And it seems unlikely that Java will displace Windows as the dominant desktop operating system any time soon, as some had predicted might happen.

One last operating system we'll be hearing about is Windows CE, which will start showing up in numerous devices other than general-purpose computers. Windows CE is the operating system now found predominantly in hand-held and palmtop computers such as the Casio Cassiopeia A-20, the Hewlett-Packard 620LX Palmtop PC, and the Sharp Mobilon HC-4500C. But Microsoft is pushing Windows CE beyond those devices, so consumers can expect the op-

erating system to show up in computer-controlled automobile consoles, stereos, set-top boxes for use with cable television, and other applications that don't seem to be obvious uses for CE today.

In 2001... Once-impossible software techniques and applications are about to be made possible by 64-bit addressing.

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User Interfaces

Personal computers will start to see, hear, and maybe even think the way humans do, but the graphical user interface will be around for a while longer.

By John Morris

THE DATE IS APRIL 2001. AS YOU RISE from bed, you give a quick command and your computer instantly awakens and reads your new e-mail to you. On a train on your way to work, you scribble a few notes on your computer's touch pad. Once you arrive at the office, your computerized assistant provides a rundown of the day's telephone calls and tasks.

After making a few calls, you tell your personal computer to send an e-mail and dictate the contents of the message. At the end of the day, another software assistant fetches the latest news and information, which you can browse or listen to on the way home. If you get home late, your personal computer has recorded not only your voice messages but also your favorite television shows.

Although this scenario has long been the stuff of imagination, rapid advances in personal computer hardware and software will soon make it a reality. Cheaper and more powerful personal computers are making it possible to perform processor-intensive tasks on the desktop. Breakthroughs in technology, such as speech recognition, are enabling new ways of interacting with computers. And the convergence of personal computers and consumer electronics devices is broadening the base of computer users and placing a new emphasis on ease of use. Together, these developments will drive the industry in the next few years to build the first completely new interfaces since SRI International and Xerox's Palo Alto Research Center did their pioneering research into graphical user interfaces (GUIs) in the 1970s.

True, it's unlikely that you'll be ready to toss out the keyboard and mouse by 2001. In-

deed, a whole cottage industry—inspired by the hyperlinked design of the World Wide Web—has sprung up to improve today's graphical user interface. Companies such as CoCo Systems (www.coco.co.uk), Natrifical (www.natrifical.com), and Visualizing Ideas (www.mindman.com) are developing products that organize information graphically in more intuitive ways. And Netscape is working on a new, XML-based format that will enable users to view content, including local and network files, within a single browser interface. But it is the more dramatic innovations such as speech recognition that are poised to shake up interface design.

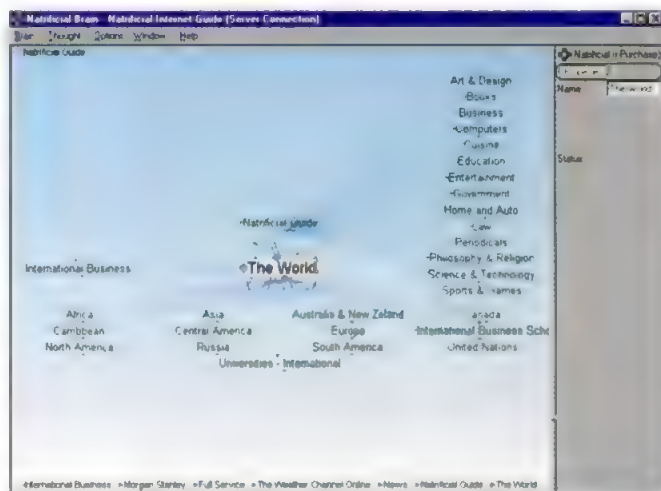
Speech recognition has garnered much

attention recently, thanks to the arrival in 1997 of continuous-speech recognition programs from Dragon Systems, IBM, and Lernout & Hauspie Speech Products. Within the next five years, speech will become a major component of user interfaces. In the short term, speech recognition will continue to be added to existing

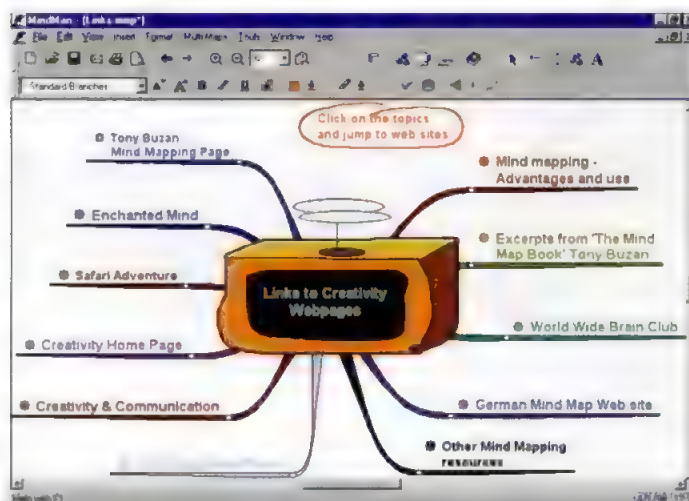
programs. For example, Dragon Systems has publicly demonstrated speech-enabled versions of Microsoft Outlook and Lotus Notes. In the longer term, applications will be completely redesigned to incorporate speech input.

"I don't think we've yet seen a breakthrough in which an application has been totally redesigned in its look and operation for using speech as its main interface," said Joel Gould, lead architect of Dragon's NaturallySpeaking. "By this time next year, there will be two or three major ones."

In some settings, speech



The Brain, from Natrifical Software Technologies, offers an alternative interface to browsing the Web, as well as managing files and documents from other applications.



Mindman 3.0, from MindJET, uses "mind-mapping" graphical representations instead of lists to express complex ideas.

input will be more than beneficial: It will be essential. Microsoft plans to ship the Windows CE-based Auto PC, which will have a speech-enabled interface and provide access to e-mail and paging services as well as directions and traffic alerts. Palm-size and handheld PCs, with their cramped keyboards and basic handwriting recognition, will also benefit from speech technology.

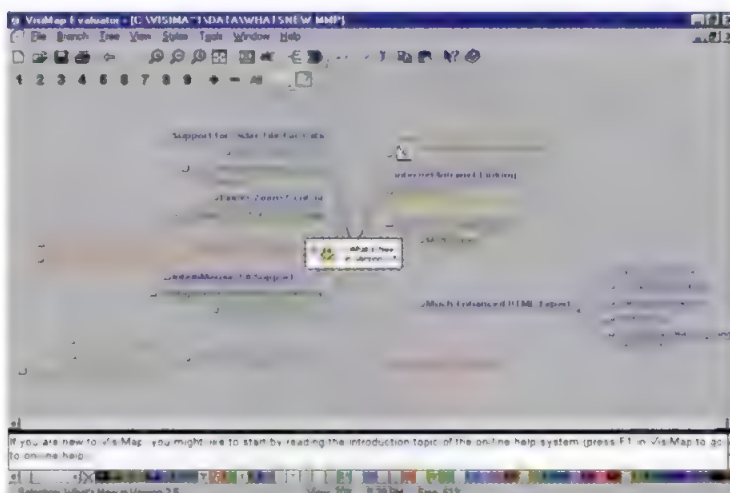
Though speech recognition may never be a complete replacement for other input devices, future interfaces will offer a combination of input types, a concept known as *multimodal* input. A mouse is a very efficient device for desktop navigation, for example, but not for changing the style of a paragraph.

By using both a mouse and speech input, a user can first point to the appropriate paragraph and then say to the computer, "Make that bold."

Of course, multimodal interfaces will involve more than just traditional input devices and speech recognition. Eventually, most PCs will also have handwriting recognition, text to speech (TTS), the ability to recognize faces or gestures, and even the ability to observe their surroundings.

At The Intelligent Room, a project of Massachusetts Institute of Technology's Artificial Intelligence Lab, researchers have given sight to PCs running Microsoft Windows NT through the use of video cameras (see the sidebar "MIT: Wearable PCs, Electronic Ink, and Smart Rooms"). When someone in the room asks for information, the PCs can recognize the request, search the Internet for that topic, parse the page to locate exactly the right information, and deliver it to the monitor closest to where the inquiring person is standing.

"Up to now, the PC hasn't cared about the world around it," said Rodney A. Brooks, the Director of MIT's Artificial Intelligence Lab. "When you combine



VisiMap, from CoCo Systems, creates visual maps in which branches can link to data files, Web pages, and other maps.

computer vision with speech understanding, it liberates the user from having to sit in front of a keyboard and screen."

One early application of computer vision could be intelligent videoconferencing. By

In 2001...
The question is not "what does software look like," but "how does it behave?"

observing and reacting to the body language of those involved in a meeting, a PC with computer vision can give a business meeting a face-to-face feel. To be truly effective, computer vision systems require multiple cameras—something today's PCs can't support, because of their limited input and output capabilities. So at least for the next few years, these advanced

applications aren't likely to find their way out of research labs and onto the desktop.

"In our labs we've gotten beyond that [the GUI], but I don't think that such technology will be out in the real world by 2001—we're probably stuck with the keyboard," Brooks said. "But perhaps not long after that."

It's no secret that the amount of information—both on the Internet and within intranets—at the fingertips of computer users has been expanding rapidly. This information onslaught has led to an interest in *intelligent agents*, software assistants that perform tasks such as retrieving and delivering information and automating repetitive tasks. Already, some 50 companies are developing agent software or services such as Firefly (www.firefly.net) and WiseWire (www.wisewire.com).

By 2000, intelligent agents will be used in a range of applications, including user interfaces, desktop applications, messaging, commerce, and network management, according to a survey by the GiGa Information Group.

Agents will make computing significantly easier. They can be used as Web browsers, help desks, and shopping assistants. IBM's Web Browser Intelligence (Webby), for example, is a prototype application that watches while you browse and records how often you visit sites, so that it

can automatically download your favorite sites. More advanced agents such as IBM's Java-based Gingko can "learn" about a user's preferences and predict the user's behavior.

Combined with the ability to look and listen, intelligent agents will bring personal computers one step closer to behaving more like humans. This is not an accident. Researchers have long noted that users have a tendency to treat their personal computers as though they were human. By making computers more "social," they hope to also make them easier to use.

That is the thinking behind Persona, a project at Microsoft's User Interface Research group. Building on the Whisper speech engine developed by Microsoft and natural-language-processing technology, the group has created a lifelike computer assistant—a 3-D animated Parrot, named Peedy—that can interact with the user in a conversational manner. It lets the user search for specific music CDs and instruct Peedy to play them. To handle more complex computing chores, lifelike characters will need improved speech recognition, more flexible natural-language processing, and better speech synthesis.

As these technologies enter mainstream applications, they will have a marked impact on the way we work with personal computers. By 2001, the question will be not "what does software look like" but "how does it behave?"



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Software Agents

The bouncing paper clip of Microsoft Office could give way to agents that know you well enough to go out and get the information you need.

By Richard Dragan

THE LEGACY OF ARTIFICIAL INTELLIGENCE, *agents* (software that performs tasks automatically) will ultimately reach a wide audience in the next few years, making Web sites and applications smarter. And though in 2001 agents will still have a long way to go, the convergence of secure Internet commerce and new standards that protect consumers promises a bright future for agents on the Web.

By 2001, *collaborative filtering*, which applies recommendations from a community of users to individual users, will be common on the Internet. Through this technology, users are asked to rate a dozen or so movies, for instance, and the collaborative filtering agent recommends movies by matching users' preferences to like-minded users. Behind the scenes, collaborative filtering algorithms may be supplemented by neural networks and by other techniques.

One of the problems with this technology

is the difficulty it entails in storing users' preferences. If users could take their network identities with them as they jump from Web site to Web site, they could—for

example—have their tastes in books from an online bookstore reflected when they browse a movie Web site. One of the biggest concerns about handling personal information on Web sites is the issue of privacy. Clearly, unbridled access to Web

surfers' preferences by vendors could result in junk mail or worse. With the looming threat of government intervention in privacy issues, the industry has responded with a new standard called the Platform for Privacy Preferences Project (P3P).

The P3P standard should go a long way toward fostering collaborative filtering agents on the Web, by letting users carry their *passports* (network identities) with them from site to site. The potential for Internet commerce will surely increase as

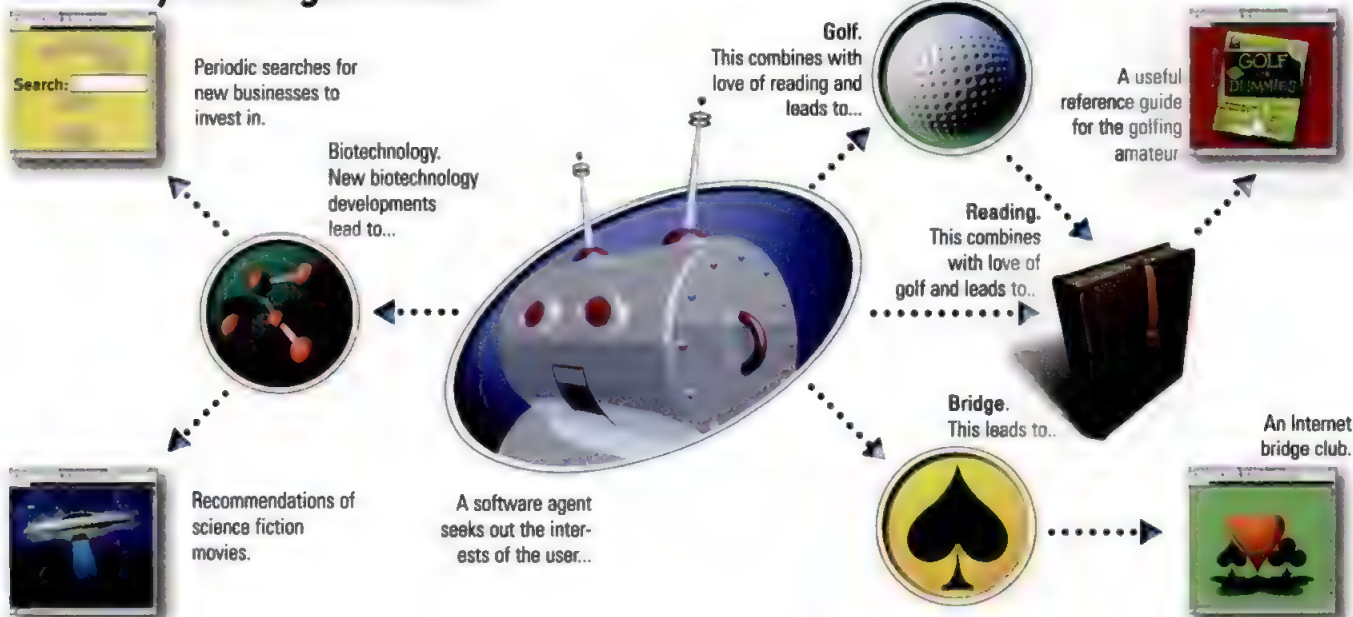
products and content are customized across Web sites for the same user. Moreover, P3P will help protect private information, so users will be able to store address and credit-card information with reputable Web sites from which they have previously bought products.

The most advanced notion of an agent, the mobile agent, is not standardized yet. *Mobile agents* are programs that move from Web site to Web site, performing functions that range from information searches to product searches. Because these agents behave like actual, autonomous programs, issues of security are critical. A malicious agent could overload a Web site with multiple copies of itself. The idea of the mobile-agent is very appealing and has always attracted a lot of admirers, given the agents' potential ability to transform the way we work. But without mature standards for creating and running mobile agents, users won't see widespread use of them for several years. In the short term, mobile agents will be used primarily in specialized applications and in messaging systems for pagers and other hand-held devices.

The infrastructure for using agents is just now forming, and the payoff in the near future will be more personalized content, increased Internet commerce, and a richer computing experience.

In 2001... Agents let users carry network identity "passports" from site to site.

How a Software Agent Works



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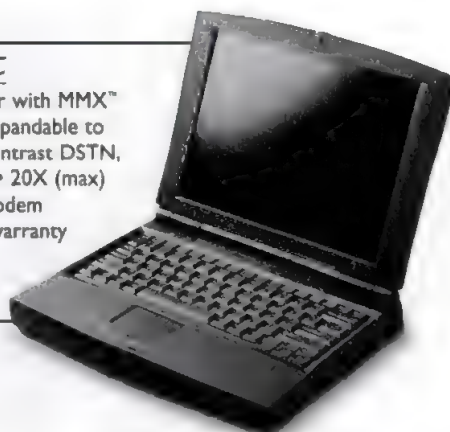
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Viruses

The biggest threat will be a virus that hops from system to system, crippling the Internet and PCs connected to it.

By Ben Z. Gottesman

ONE THING IS CERTAIN WHEN IT COMES to computer viruses: They're here to stay.

An estimated 16,000 viruses have been encountered by various antivirus research labs, and that number is expected to continue growing rapidly. Of course, the number of viruses actively spreading in the wild is considered to be much smaller—fewer than 1,000.

Though it is difficult to predict what the next major class of virus will be or when it will hit, the place it hits is likely to be the Internet. The threat will probably be similar to the 1988 Internet worm—a program that hopped from system to system, quickly crippling the Internet. Viruses require some level of human involvement to spread, such as exchanging disks or posting an infected file on a server. But a worm moves from system to system by itself, actively seeking out new computers to infect.

Researchers at IBM's Thomas J. Watson Research Center have laid out a blueprint for an automated system that can identify new viruses as well as develop and disseminate the antidotes. The software would identify a previously unknown virus by either analyzing changes to a file or studying the characteristics of a file for code common to viruses. When a potential virus is identified, the infected file would be sent securely to the IBM virus-lab computer. If the virus is known but not recognized by the user's system because of out-of-date software, updated antivirus data would be sent back to the user.

If the virus is truly unknown, the virus-lab computers would let it spread within a secure environment and then study the way the virus behaves, extracting its signature based on the common characteristics of the infected files. The

signature would be tested to ensure it didn't misidentify clean files as infected. If the signature passes, it would be sent back to the machine on which the virus was originally identified and the virus would be removed.

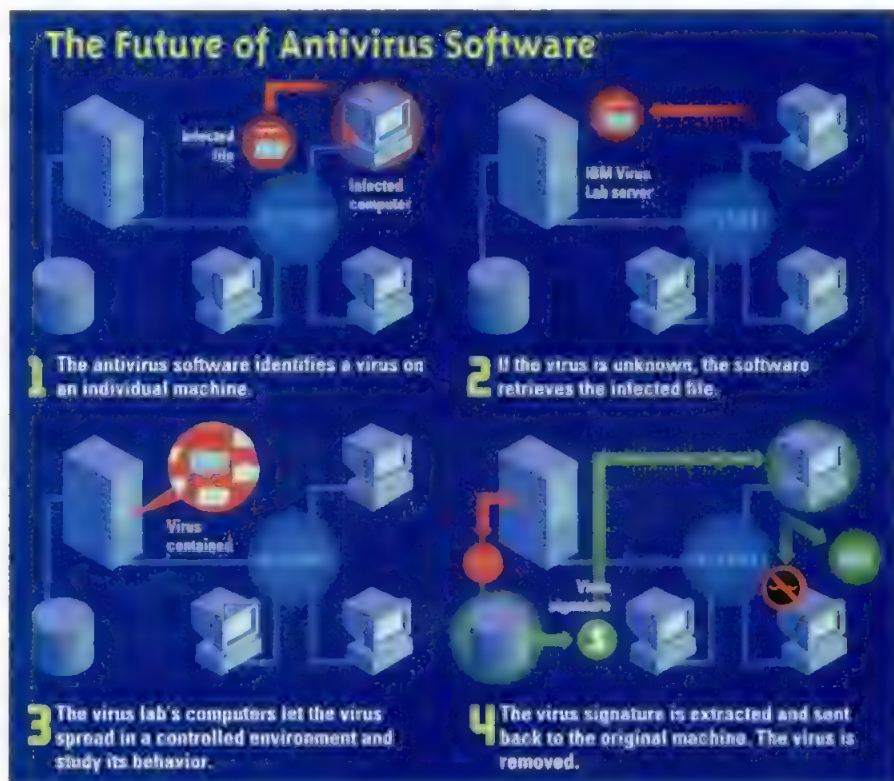
IBM estimates that the entire process should take only about 3 minutes. Within a day, the updated virus signature would be sent out to all computers running IBM's software, protecting them from possible infection. This automated system would be significantly faster than the manual process used in today's antivirus software, which typically takes several weeks to a few months to send new virus signatures to all subscribers.

In 2001... As worm viruses threaten the Internet, anti-virus software works to keep connected PCs safe from harm.

Other challenges face the antivirus community in the coming years. As computer prices continue to drop and more users get connected, the general level of user sophistication goes down. Preying upon this fact, hoaxes have begun to spread around the Internet like wildfire. They are so prevalent that most users are more likely to be bothered by hoaxes than by actual viruses.

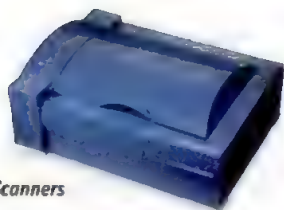
A hoax typically takes the form of an e-mail message: It warns the user of a virus spreading as part of another e-mail message that will cause damage to the user's computer. The message urges users to forward the warning to all their colleagues. In fact there is no virus, but the hoaxter's message can take on viruslike characteristics as it replicates from system to system via e-mail. Although it is possible for a virus to spread via e-mail, such a virus has yet to be seen in the wild.

Most users do not understand the difference between viruses and other malicious threats. Because of this, antivirus vendors will have to continue extending their products to address more types of security problems, as well as to better detect the rapidly increasing number of viruses.



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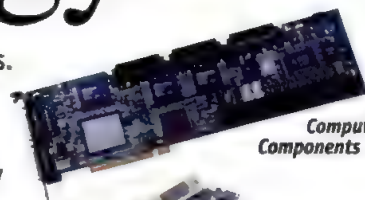
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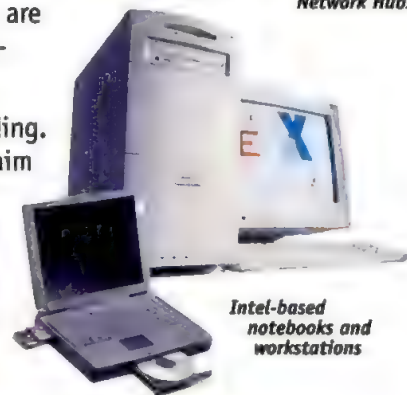
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Databases

Hybrid databases will incorporate the best features of relational database management systems and object-oriented products.

By Richard Dragan

THE CORPORATE DATABASE WILL BE ABLE TO mix and match data like never before in the years to come, thanks to the interoperability of Java running on CORBA (Common Object Request Broker Architecture) and DCOM (Distributed Component Object Model). With this technology gaining a firm foothold today, the average corporate developer in 2001 will have no trouble thinking in terms of distributed and parallel computing. More Web servers will get data from multiple sources on the back-end, either through mainframes, relational database management systems (RDBMS), or object-oriented databases.

Object-oriented databases let you create new data types that consist of the traditional attributes found in relational models as well as built-in functions and methods. This technology also offers significant performance gains by allowing actual objects to be stored on the server. Pure object-oriented databases are an appealing alternative for applications that require video or other specialized content.

Standards such as ODMG-93 by the Object Data Management Group will help regulate this technology. Realistically, just as individual vendors enhance SQL (Structured Query Language) for the relational model with individual tweaks to syntax, there's no reason to think that object-oriented query language will have greater adherence to a universal standard. Computer Associates, for example, has developed its Jasmine object-oriented database using a proprietary language.

Despite recent advances in object-oriented database technology and standards, it's unlikely that the relational database will disappear anytime soon. Although object-oriented databases can offer a significant

performance edge over relational databases when queries are known beforehand, query optimization for relational databases are better known, and RDBMS vendors have a head start on their OODBMS rivals.

One testament to the staying power of traditional RDBMS technology is the growing interest in data mining and data warehousing. Data warehousing involves the collection of data from legacy mainframe and PC server databases into massive central databases, often measured in terabytes. Because of the tremendous size of these databases, look for mainframes and 64-bit platforms to be the staple workhorses.

Better and faster hardware will put data mining into reach for large corporations. Using knowledge discovery and data-mining techniques, a corporation can examine factors and trends in, for example, their sales and marketing data. This type of research is particularly challenging because important or significant traits are not known beforehand and must be discovered in massive databases with millions of records. Despite this, data mining is certainly a mainstream trend that will grow in the near future, and products such as Sybase's IQ (Version 11.2) are already bringing this about.

The battle lines for the future of the corporate database have been drawn for some time. On one side is the tried-and-true RDBMS, used by corporations for decades; on the other are new object-oriented database products from vendors such as Computer Associates, Objectivity, and POET Software. Sybase, long known as a leader in relational technology, has hitched its wagon to the future to object-oriented databases.

Vendors will successfully stave off the rush to purchase true object-oriented products by adding object capabilities to traditional RDBMS products. These hybrid approaches maintain backward compatibility with the tried-and-true relational server model, with its robustness and tremendous installed user base. At the same time, they let programmers create custom data types.

Though this approach will not please object purists, look for it to gain ground in the future as a pragmatic middle alternative to the enormous legacy of installed RDBMS's. A good mix is the model adopted by such vendors as Microsoft and Oracle, which combines the ability to translate an object-oriented world into the relational model on the back end.

Microsoft's OLE DB (Object Linking and Embedding Database) technology lets objects on the front-end map to an SQL server on the back-end through DCOM. An enhanced SQL language, SQL3, should also be in place in a few years, which will allow traditional RDBMS products to model objects.

The heart of corporate America will still be loyal to the RDBMS in 2001, and the dominant database model will be object-relational hybrid. Pure object-oriented databases will remain primarily for shops that require the cutting edge in database technology.

In 2001... Advanced databases let Web servers get data from multiple sources on the back end and allows Web sites to integrate queries.

Database Debate: Relational vs. Object-Oriented

	Relational	Object-oriented
How data is stored	Data is normalized and stored in rows using indexed fields. The query engine joins tables using key fields.	Pointers between objects are used to represent joins.
Language	Structured Query Language	ODMG-93-compliant data-manipulation language, which can be proprietary.
Advantages	A loyal installed base of major corporations, a proven track record.	A significant performance edge when queries are known beforehand.
Major suppliers	Microsoft, Oracle, Sybase.	Computer Associates, Objectivity Inc., POET Software.

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Encryption

With mind-boggling complexity, advanced encryption techniques will bring electronic commerce and digital cash closer to reality.

By Richard Dragan

IN JUST A FEW YEARS, ENCRYPTION WILL bring about a more secure Internet, the widespread use of digital cash, and codes that take more days to crack than we have left on earth.

The infrastructure for a secure Internet is already in place. Packet-level and e-mail encryption are already in use, and the SSL3 (Secure Sockets Layer) standard has paved the way for secure transactions. VeriSign has issued over 750,000 digital IDs for authenticating users on Web sites and for sending and receiving secure e-mail.

These standards, as well as emerging technologies such as smart cards and digital cash, will help Internet commerce thrive. Smart cards as a substitute for cash are already being test-marketed in several major U.S. cities. Paper money will not be obsolete by 2001, but several electronic alternatives will be available. International electronic commerce will also grow: Although the Department of Commerce restricts the exportation of encryption technologies to software with 40-bit keys, both Microsoft and Netscape have re-

using public-key cryptography: Messages are encrypted by the sender using a public key, then decrypted by the recipient using a private key.

This algorithm is based on the difficulties of factoring very large prime numbers. With the private key in hand, the factors can be quickly discovered, but without the key, discovering the factors is an extremely difficult computing task. Barring a new mathematical discovery, this method of encryption is demonstrably secure and will probably remain widely used on the Internet. Although new types of encryption are being developed in the cryptographic research community, the preeminent position of RSA's method makes it the one to watch for encryption in the future.

In the cat-and-mouse game of cryptanalysis, messages can theoretically be broken without the private key. Experts speak of a cypher's *keyspace*, which is expressed in bits. The greater the length of

about 228 years to crack the Data Encryption Standard (DES), which uses a 56-bit key. With RSA's 128-bit key standard, such an attack is nearly impossible—a hacker would need over 10^{24} years to break the encryption, much longer than the projected lifetime of the Earth.

Apart from a brute force attack, a *key-escrow system* is the only way to decrypt data without knowing the private key. In such a system, an official key-escrow organization is entrusted with ei-

ther a copy of the private key or a special data-recovery key. A law enforcement official could obtain a subpoena and bring it to the key-escrow organization, which would then decrypt the data in question. A similar scheme was proposed for the ill-fated Clipper Chip initiative of a few years ago. Judging by the ensuing uproar and the high-tech sector's reluc-

tance to be regulated, don't look for key escrow by the government to come about by 2001.

Of course, in encryption as in real life, people lose their keys, and corporations will naturally be interested in the recovery of encrypted data. As a result, expect a growing market for key maintenance and the recovery of encrypted data.

Although 128-bit encryption will likely stand the test of time for the foreseeable future, faster CPUs and more parallel processing may put 40-bit and 56-bit DES encryption at risk, conceivably within a few years. Evidence that DES is in jeopardy already exists: Messages encrypted using this standard have been decrypted by academic researchers.

The year 2001 will likely see the end of 56-bit DES as a legitimate cryptography standard. The government is currently looking at a successor, the Advanced Encryption Standard, which may feature up to 256-bit encryption. But the results will probably not be available for several years. Although other facets of encryption technology have developed quickly, governments have proved slow to adapt to the changing encryption needs of PC users.

In 2001...
The United States government's control of encryption technology continues to dwindle.

Encryption Table		
In cryptanalysis, messages theoretically can be decrypted without the private key. The greater the length of the cypher's key space, expressed in bits, the less susceptible the code is to a brute-force attack.		
Type of encryption	Key size	Time needed to break code
Weak Encryption	40 bits: $2^{40} = 1.1 \times 10^{12}$ possible keys	30.5 hours
Data Encryption Standard (DES)	56 bits: $2^{56} = 7.2 \times 10^{16}$ possible keys	228 years
RSA	128 bits: $2^{128} = 3.4 \times 10^{38}$ possible keys	1.07×10^{24} years

cently been given permission to export products with 128-bit encryption for use with banking and financial transactions.

Strong 128-bit encryption has been available in browsers for several years and is now standard for both Microsoft Internet Explorer and Netscape Navigator. The algorithms for strong encryption are well known. The most widely accepted is RSA Data Security's encryption scheme

the keyspace, the less susceptible the code is to a *brute force attack*—an attack in which every possible numerical key is tried in sequence.

For example, a computer hacker would need, at most, 30.5 hours to break a weak 40-bit encryption, assuming the hacker could somehow harness 1,000 CPUs and type 1,000 characters per second. Using the same parameters, the hacker would need

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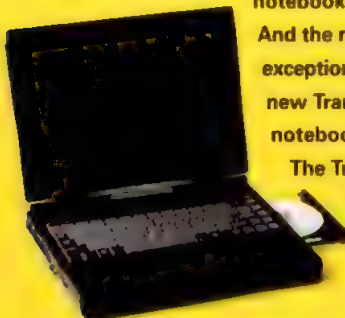
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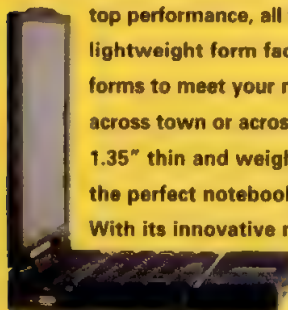
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Microsoft: Whisper and Steam

By Cade Metz

Microsoft Research is not your father's R & D operation. Headquartered in Redmond, Washington, this seven-year-old laboratory is home not only to engineers and computer scientists but also to linguists, sociologists, and mathematical physicists. At MSR (www.research.microsoft.com), programming tools and OSs are of great importance, but so are speech-based user interfaces, PCs that will one day understand English, and even the math that describes boiling water.

"Most groups at Microsoft Research are working on products that are maybe 2 years out or 5 years out," says Christian Borgs, a mathematical physicist in MSR's Theory group. "Our product is 30 years out." "Try 100 years out," corrects his wife and colleague Jennifer Tour Chayes. In truth, the two have no explicit product in mind. Little more than a year ago, after hearing about Chayes' work with phase transitions and nonpolynomial hard problems, Microsoft's chief technology officer Nathan Myhrvold suggested she bring her research to MSR. Incredulous, Chayes asked how Microsoft could possibly benefit from such theoretical subject matter. "I don't know," responded Myhrvold. "But somehow we will."

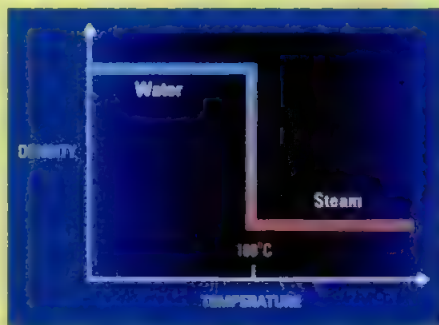
A nonpolynomial hard problem cannot be solved in polynomial time: In other words, there will never be enough time to solve it. One such problem involves phase transitions—such as the transition of water to steam (see illustration). As water is heated from 1° C to 99° C, its density changes minimally but continuously. The same is true of steam heated at 101° C and beyond. At 100° C, however, there is a discontinuity, a lack of "smoothness" in the function that describes the system. You know what all the molecules are doing at 99° C and at 101° C, but you can't possibly figure out what they are doing at 100° C. That would require exponential time.

Chayes is not trying to solve such problems; she's examining their structures. Though her work seemed irrelevant to the world of computer science before she arrived at MSR, she soon realized that nonpolynomial hard problems are ideal for data encryption. But encryption products using Chayes' work are not in Microsoft's immediate future. "We're bothering to think about these things, honestly, because it's cool," says Chayes, "and Nathan wanted us to

come here because he thought it was cool too."

Xuedong Huang and MSR's Speech Technology group are bent on improving the PC's ability to generate speech and recognize the natural speech of end users. His text-to-speech (TTS) engine, which will soon ship with Windows NT 5.0, converts typed English into clear digital audio. The group's speech recognition engine WHISPER (Windows Highly Intelligent Speech Recognition) makes the opposite type of conversion, transforming natural spoken English into digital text. With a vocabulary of 64,000 words, it operates effectively after about half an hour of training by the end user.

The engines are imperfect—WHISPER makes such mistakes as printing "ha, ha" when a phone rings, and TTS is far from sounding lifelike—but Huang and his colleagues release a new speech API every 12 months. "What you eventually want," says Huang, "is a conversational system."



One of the nonpolynomial hard problems being studied by MSR's theory group concerns the transition of water to steam.

Yet a truly conversational system must add speech understanding to mere speech recognition. Such is the aim of Bill Dolan and MSR's Natural Language Processing group. "Our goal is the ultimate," says Dolan, a Ph.D. in linguistics. "We want to take any kind of natural language input—whether it's text or speech—and map that into some sort of structured representation of its meaning that the machine can act upon." To truly understand natural language, a machine must first

isolate and recognize each word, determine syntax (how words interact to form a sentence), analyze the semantics (to understand the meaning of each word and thus each sentence), and then examine groups of sentences at the discourse level.

Dolan's group has progressed to the semantic level, shipping part of its syntactic analysis engine as the Microsoft Office 97 grammar checker. The group's NLP (Natural Language Processing) software constructs a hierarchical word tree that describes a sentence's rough grammatical construction, something like the sentence diagrams that grade-school students make. Using a semantic knowledge database known as MindNet, the software attempts to discern the meaning of each word and, ultimately, the meaning of the sentence. MindNet is many years from full semantic understanding, but the more text it analyzes, the more it understands. "It will take us a while," says Dolan. "Each sentence is a potential bug."

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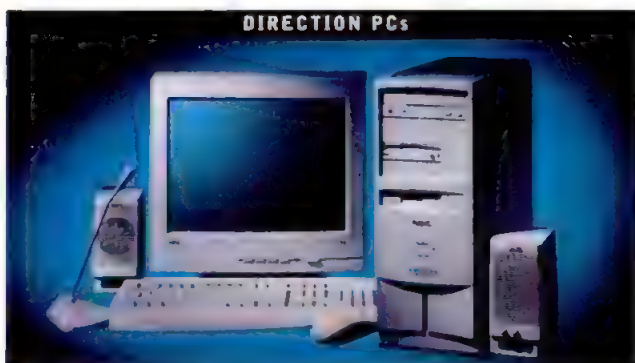


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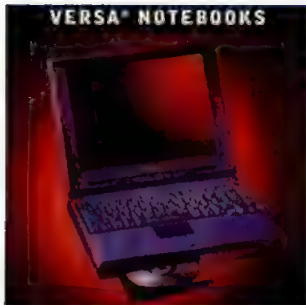
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Component Software

Microsoft's Component Object Model, the Common Object Request Broker

Architecture, and Sun's JavaBeans will boost programmer productivity.

By Larry Seltzer

ONE OF THE GREAT ADVANCES IN programming productivity in the next few years will be the continuing rise of component software.

Components are objects designed in such a way that developers can easily incorporate them into a larger program without knowledge of the component's implementation details. Some types are known to the operating system at runtime and gain extra capabilities as a result. The component market is solidifying around three significant component standards: Microsoft's Component Object Model (COM), the Common Object Request Broker Architecture (CORBA), and Sun's JavaBeans.

COM is increasingly becoming the preferred way to program Windows. Within a few years it will be the only way to program many of Windows' fea-

Another way Microsoft will make COM programming irresistible is with the Windows Scripting Host (WSH), a COM-based scripting language that will come with Windows 98 and Windows NT 5.0.

WSH scripts will be useful in invoking COM objects in Windows and third-party applications to perform a variety of customization and system maintenance functions.

Microsoft will be releasing a technology called COM+ within the next two years. COM+ will automatically integrate support for Microsoft's Transaction Server in COM programs and add programming language features to make

COM coding a seamless part of the language's object syntax.

CORBA is a specification implemented by many vendors for objects that are programming language-independent and can be executed locally or across a network. Many companies—among them IBM and SunSoft—write Object Request Brokers (ORBs), system software that actually manages the objects. Applications support for CORBA is easy to find in such programs as Netscape Visual JavaScript and Oracle's Developer/2000.

Still, a lack of security standards could limit CORBA's usefulness.

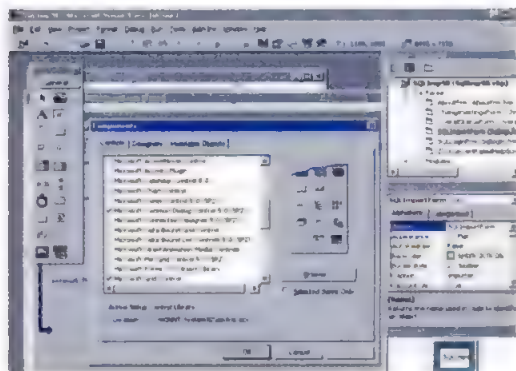
Largely as a by-product of its Windows-specific nature, COM uses Windows NT security as an object-security model.

CORBA will continue to be a useful standard for tying together applications on heterogeneous networks, but on homogeneous ones (especially Windows net-

works) and those on which security is a major issue, it won't be able to compete against COM except in one case: JavaBeans, the component standard for the Java language. There is an emerging third-party market for JavaBeans, smaller than for COM controls but growing steadily.

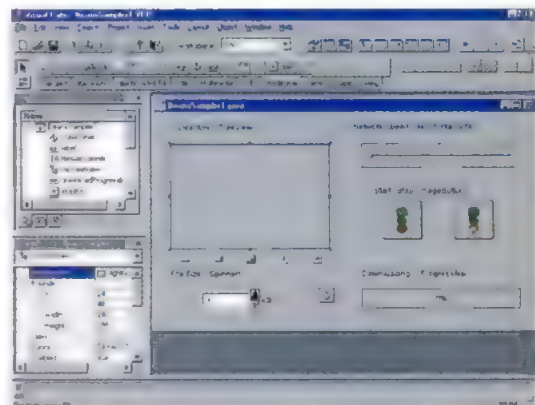
JavaBeans as a component model has some technical deficiencies that will limit its usefulness to mainstream developers. JavaBeans lacks a standard way to bind controls to data in a database, a very common operation. This is the main reason

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Gaps in features
between Sun's
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Microsoft's arise
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ActiveX controls are the foundation of the Microsoft Visual Basic 5.0 RAD programming tool.

tures. New features, such as the Active Directory Service Interface (ADSI) will be available only through COM interfaces. The market for COM controls is enormous and growing and will become a large percentage of the Windows software market.



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that beans from different vendors frequently don't work well together.

But JavaBeans has too many backers and compelling features to go away. Practically everyone but Microsoft is backing Sun's Enterprise JavaBeans (EJB) effort, which will create a standard set of server-side system services in Java. Mostly because of EJB, Java will ultimately emerge as the standard way to deliver CORBA objects, but it won't be the only way. Customers won't accept Java for many solutions, so the incompatible native-code implementations will maintain their presence, their drag on widespread acceptance of CORBA, and the consequent competitive advantage to COM in many markets.

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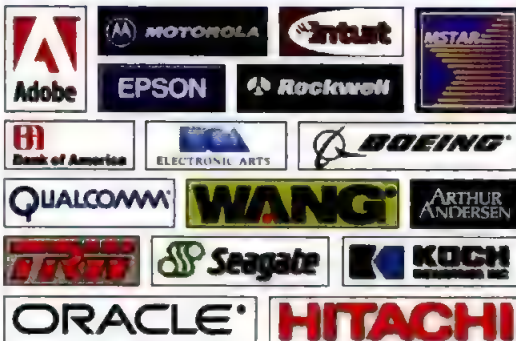
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Virtual Reality

Teams of workers will visually explore virtual prototypes together
and interactively conduct simulations through VR techniques.

By Linda and Erick Von Schweber

VIRTUAL REALITY (VR) WILL SOON become commonplace, found throughout the enterprise as a comfortable companion in the consumer's home and a regular component of the desktop. Unfortunately, VR in education will lag until hardware in schools catches up with that of the business world.

Desktop VR, supported by networked infrastructures, already lets engineers who are distributed geographically function as a group. New immersive interface technologies such as the Vision Dome from Alternate Realities Corporation, the CAVE and Immersadesk from Pyramid Systems, and the Immersive WorkBench from Fakespace, let teams of workers visually explore virtual prototypes together and conduct simulations interactively.

By 2001, this will result in 3-D collaborative enterprises, where teams throughout the company join forces to compress the design-to-delivery cycle and produce better products. Design, engineering, finance, quality assurance, manufacturing, marketing, and sales will work together on the same data using real-time 3-D visualization—often via the Internet.

Desktop VR, augmented by the Web, will enable mass customization applications, leading consumers across the globe to become their own producers and build 3-D worlds in the 3-D marketplace. Shoppers in Europe can already browse furniture and design elements

on the Web in 3-D using VRML, then change such attributes as finish, fabric, color, faucets, fixtures, and dimensions—and even configure and order whole rooms. Manufacturers benefit from better understanding and tracking of customer desires while products are still in the design stage, and customers get more of what they want. This synergy will attract many markets to this new paradigm by 2001, integrating the final consumer into the digital supply chain.

Many new PCs feature hardware-accelerated 3-D graphics, and they will be optimized for real-time 3-D thanks to Visual PC initiatives pursued separately by Intel and Silicon Graphics. Visual PCs will accept a new wave of lightweight, head-mounted displays called PDs—personal displays. The first of the PDs will debut this year from Retinal Displays. They will employ gyroscope-based motion trackers that keep user movements and the virtual world in synch at 30 fps.

Visual PCs will also power a desktop Vision Dome, allowing a family to

be immersed together in the 3-D marketplace, VR games, and even TV. The desktop business user will be supported too, with VR applied to data visualization, presentations, groupware, and training. Real-time 3-D will pop up in management and productivity applications on and off the Web. Platinum Technologies will embed VRML-based 3-D into nearly a third of its 150 applications, beginning with the data-analysis product Forest and Trees. Intervista Software, known for its WorldView VRML 2.0 browser, has introduced WorldChart, a utility that creates VRML models out of Excel data. And Sense8 Corp. is working on making its virtual-reality software much easier to use, more like producing Microsoft PowerPoint slides than like programming in Microsoft Visual Basic.

IBM's demonstration of inverse synchronous-communication technology proves that groupware can exploit VR too, with users represented by 3-D likenesses called avatars that meet in virtual spaces, have discussions, and conduct design reviews. VR has also proven itself in training, with workers trained in VR performing 20 percent better than those trained with traditional methods.

Many users want to know when they'll see a VUI—a visual user interface that is the 3-D successor to the 2-D graphical user interface (GUI). We'll see movement in this direction by 2001: A GUI that employs multiple layers with transparency, a zooming function to expand and contract the workspace, and 3-D sprites that offer assistance. This interface will probably be based on XML, the proposed follow-on to HTML.

Real-time interactive 3-D will have integrated itself so tightly into our computing environment by 2001 that we might not even call it virtual reality. Instead, we'll wonder how we ever questioned the need for and value of these powerful capabilities. PC

In 2001...
Workers
produce and
consumers buy
in a 3-D virtual
marketplace
that transcends national
boundaries.



Internet Connectivity

Fast-access services, cable modems, digital subscriber lines, and

ISDN will be available on a neighborhood-by-neighborhood basis.

By Frank J. Derfler, Jr.

A MAP SHOWING AREAS OF FAST INTERNET and intranet local access in 2001 is a splotchy thing. The fast-access services—cable modems, digital subscriber line (DSL), and even the venerable ISDN—will be available on a neighborhood-by-neighborhood basis. Generally, DSL will be in businesses and on campuses, whereas you'll find cable modems primarily in residences. Nevertheless, a home or business across the street may have cable-modem or DSL service while it's unavailable to you. The odds of receiving fast service will get much better than they are today, but utopia may have to wait. Tens of millions of customers will have service that is faster than an analog modem, but hundreds of millions of potential customers will not.

The telephone wires going to each home or business can provide faster-than-analog-modem data access in one of two ways: DSL or ISDN. ISDN is a dial-up ser-

vice using 20-year-old technology, but it will be just hitting its stride at the millennium in terms of availability and ease of use. With ISDN service, you can call any other ISDN number in the world at 128 Kbps. In fact, you can call two destinations at the same time at 64 Kbps each. ISDN will be a mainstay technology for corporate, home, and small-office Internet and intranet access in 2001.

Unlike ISDN, DSL is a point-to-point technology. A DSL connection is always between your point of service and the local telephone company office. A DSL service provider may be a local telephone company or a company leasing lines and even space in a building from the company. The Telecommunications Reform Act of 1995 was supposed to encourage this kind of cooperative competitive arrangement, but it simply hasn't worked, so don't expect miracles in the

deployment of DSL by 2001.

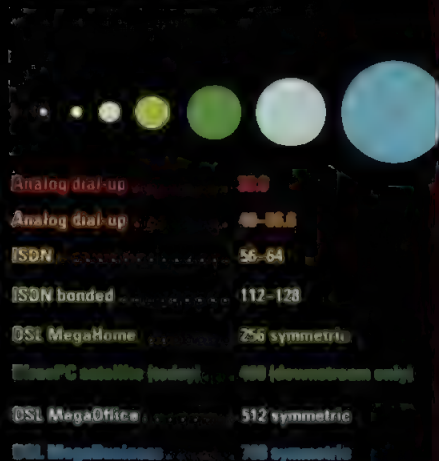
The standards for DSL won't be ironed out until late 1998, and serious deployments won't begin until the middle of 1999. Bit rates for the most typical service ideally run as high as 1.5 Mbps in the downstream direction (toward the subscriber) and 512 Kbps upstream. But in practice, variables such as the distance between the subscriber and the service provider, the acceptable error rate, noise from local electrical wiring, and the electrical characteristics of the equipment will significantly reduce throughput.

DSL will be widely used in educational and corporate campus settings in 2000, including hotels and hospitals, because it takes advantage of installed telephone wires and, unlike ISDN, doesn't require special programming in the central telephone switch. When you control your own telephone system, as campus-based

Internet Connection

Each of the new connectivity technologies promises greater bandwidth than the 33.6- and 56.6-Kbps or ISDN links we use today. Each new development promises more reliable service and increased bandwidth—as shown by the circles' diameters. By 2001 many more customers will have service faster than analog modems. Unfortunately, even more will find these services inaccessible in their areas.

All speeds are in kilobits per second.



Cable modem
 300-10,000
 (varies with speed)

organizations do, then the commercial barriers to DSL disappear and the technical challenges are easy to handle. DSL will also hit its stride in urban areas that don't have a major installed base of television cable systems for competition.

Beyond 2001, DSL will be more important as a corporate fast-connection solution than as a home-user solution. Today, telephone wires are plentiful in corporate locations, but cable connections are scarce. Often, business users don't get cable-modem service, because downtown areas and office parks weren't initially wired for television. The cost of upgrading the infrastructure to support industrial areas and office facilities in the U.S. has been estimated at \$10 billion.

Cable modem service will grow into residential markets as cable companies can afford the significant investment in new infrastructure. But the companies originally structured themselves for long-term de-

preciation of assets and high revenues from premium-channel services. The satellite television systems skimmed the cream from the premium revenues, and now the

cable companies face massive new investments to handle data. The salvation of cable services is to team up with such companies as @Home to share the burden and reduce the risk. Even in 2001, many cable-modem installations will be one-way broadcasts, with users sending data to the ISP over a dial-up telephone line and receiving data only

through the cable.

Ideally, cable modems move data from the Internet at speeds up to 10 Mbps, but users rarely see the maximum throughput, because everyone shares the bandwidth. This means that as the number of users grows, the bandwidth enjoyed by each user goes down.

Users at the bottom of the connectivity ladder—those without any of these

fast services—will find ways to cope, such as using two modems in parallel. The ability to use two simultaneous modem connections effectively is a feature of Windows 98. This feature provides the equivalent of 64-Kbps ISDN service and makes a significant difference in many Internet activities.

The ISPs that survive until 2001 will change by expanding the role of access provider in two directions. First, they'll develop broadly based local content and finely tuned, personalized content for subscribers. Second, they'll move deeper into the connection business—using new regulation and money gained through consolidations to become total connection providers. Telephone companies are ISPs now, so why can't it work the other way? The ISPs and alternative carriers will drive new connection technologies, such as LMDS and wireless MMDS (see "Wireless Communications" in this issue), that will smooth out the splotchy condition of the connection map.

In 2001...Fast connections are more than a glimmer on the horizon but still not available to all.



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Digital Leisure

Leisure activities on the Internet will include game playing, buying, and chatting in burgeoning virtual communities.

By Richard Dragan

FOR A LUCKY FEW, LEISURE TIME SPENT ON the Internet soon will include streaming video and sound, better games, and a variety of subscription services for delivering software. For a less fortunate majority, Internet connections will not be fast enough by 2001 to improve surfing significantly.

Nevertheless, chat capabilities like video and sound will increase. Chat will likely become nearly universal on most major Web sites. Although corporate users will provide most of the drive for multimedia chat, consumers will also benefit—with more events sponsored at major Web sites.

For corporate training and general education, users with access will be able to spend their time honing their knowledge of new technologies as well as traditional subjects. Learning at home—with video included for the digitally privileged—will be one of the possibilities. Expect the do-it-yourself education market to occupy some of your time online as virtual universities grow and prosper.

The convergence of the Internet and television will also provide a natural haven for virtual communities. Don't be surprised if by 2000, some users will be able to chat about a TV show in another window alongside the show itself on the same screen. Television will give you something to talk about, and the networks will take advantage of this with new chat capabilities. As more Americans get Internet capabilities on their TVs, expect special events on the home screen to blend with online programming.

The new bandwidth of the Internet will bring a host of software titles to your browser,

removing the need to buy and install a CD-ROM. One company, Arepa, is planning to work with content providers to deliver CD-ROM titles across the wire. Today, online gaming sites such as Sierra have already signed up tens of thousands of users for role-playing and strategy games, a foreseeable segment likely to grow in the future.

Subscription gaming sites will also grow and certainly benefit from the ability to stream multimedia content. With increased graphics-processing power in the near future, all kinds of simulations and games will feature richer detail and more realistic modeling. Whether on the Internet or not, your gaming time will be spent exploring worlds that blur the line between fiction and reality with more photo-realistic 3-D detail, better action, and more complex content.

In 2001... Game software is delivered and run over the Internet.

The move to put CD-ROM titles onto the Web will take some effort, so don't imagine the conversion will be complete by 2001. Beside moving to a browser-based interface, titles today often make use of Apple's QuickTime or Microsoft's DirectX. This will entail work to bring to browsers.

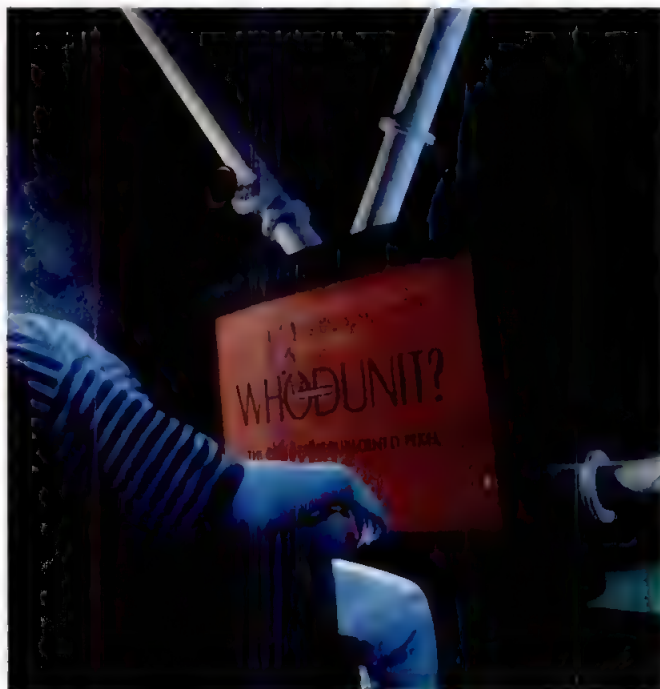
But the market for home software delivered over the Web is potentially immense. It's estimated that the consumer software market will expand from \$4.7 billion in 1996 to \$10 billion by 2001. Chances are, a good deal of that software will be delivered—and run—over the Internet. In the near future, users will benefit

from a wide array of titles and can try and buy software titles as well as use services that provide CD titles on a pay-per-use or subscription basis.

Naturally, the growth of Internet commerce means more opportunities to spend time shopping, always a popular form of recreation. Don't expect the local mall to go under by 2001, but rest assured that buying online will become a more acceptable option for mainstream buyers with the widespread adoption of the rules and standards for secure Internet commerce. As the major sites for selling books and CDs grow, you may also be entertained online as well, given the opportunities for chatting with authors and celebrities online.

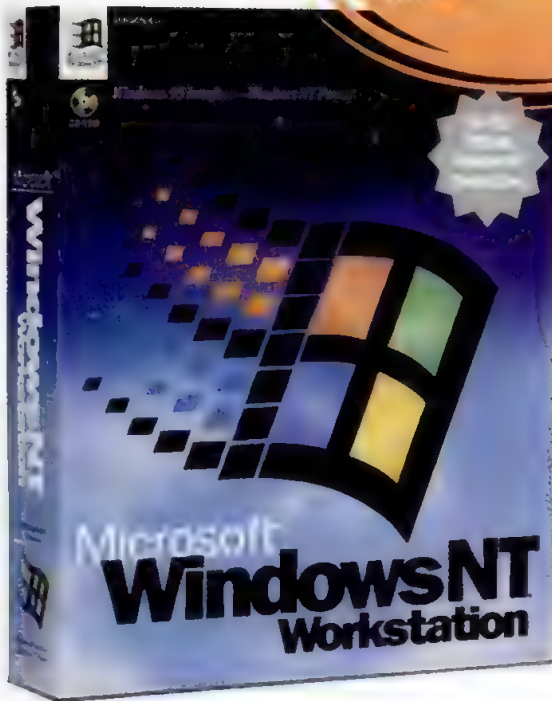
As long as you have enough bandwidth, tomorrow's digital leisure will include many more opportunities to play, buy, chat, and spend time productively in education via the Internet.

It's a vision of recreation that will greatly appeal to tech-minded consumers as well as software developers. Though not everyone will be able to indulge in this new model of computing by 2001, you'll probably know someone who will have the right combination of bandwidth, fast CPU, and rich content to make their recreational life on the Internet much richer and more compelling.



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MIT: Wearable PCs, Electronic

By Cade Metz

For years, people have wondered: *What is the next interface? What comes after Windows and mice?* says Neil Gershenfeld, a physicist at the MIT Media Laboratory. "The answer is so obvious, we almost didn't notice: The next interface is the world."

Much of the Media Lab's work is about realizing this ubiquitous PC interface, putting computational power onto our bodies and into our everyday surroundings. Founded in 1980 by Nicholas Negroponte and Jerome Wiesner, the Lab spent its first decade focused on projects true to its name—specifically, digital video and other seminal multimedia technologies. Slowly, such desktop-based development gave way to computing beyond the desktop—keyboards stitched into denim jackets, displays made from paper, bits residing in a cup of coffee.

In 1985, the Media Lab moved to its current site, an MIT east-campus facility designed by the internationally known architect I.M. Pei. The Wiesner Building, with an interior best described as a Mondrian in pastel, houses roughly 30 faculty and senior staff members as well as 164 graduate students.

Despite an academic degree program, the Media Lab's research is divided among four corporate consortia, not departments of study. Each consortium—from Digital Life to News in the Future, and from Things That Think to Toys of Tomorrow—consists of 10 to 50 corporate sponsors providing an annual budget of roughly \$5 million. All major sponsors—Hewlett-Packard, IBM, Intel, Motorola, and 3Com among them—have rights to the Lab's research and intellectual property.

The Media Lab's Wearables Symposium showcased smart clothes that may someday do everything a PC can.

Under the aegis of Things That Think, Alex Pentland—the Lab's academic head—oversees the creation of smart rooms (environments that use cameras, microphones, and computer hardware and are aware of what you're doing or saying) as well as smart clothes (garments or personal objects with similar computational abilities). "Currently, the user must be taught a command language to use a particular technology," says Pentland. "We want to turn that around, so users do what they want to do and the technology learns the rules."

To this end, Pentland and his staff are developing cars that know when you're falling asleep, digital aerobics teachers that monitor your movements and correct your form, chairs that adjust

to your body type, and machines that read sign language. So-called smart clothes, or wearables, are already part of everyday life at the Media Lab. Many of Pentland's students spend their days with battery-powered Linux machines strapped to their bodies,



Many Media Lab students spend their days with wearable PCs strapped to their bodies, computing as they walk about Cambridge.

computing as they walk about Cambridge, take notes in class, or converse with colleagues. The typical MIT wearable is a canteen-size system that attaches to your pants belt or shoulder strap. Unobtrusive leads run from the CPU to a Twiddler (a one-handed keyboard with 10 to 15 push buttons) and a head-mounted monochrome display. Researchers equipped with these machines are often referred to as cyborgs—for their

displays usually cover a single eye—but one graduate student has improved on the model by incorporating a tiny readout into the lens of his glasses. Doctoral candidate Bradley Rhodes, whose wearable display attaches to the bill of his Kangol beret, works with associate professor Pattie Maes on the development of autonomous software agents for wearables and the desktop. Software agents, in Media Lab terms, are long-lived applications that reside in the background of your computing environment and perform a given task without supervision. "They act independently on your behalf," says Rhodes, "much as a literary agent would."

Rhodes' current project is a remembrance agent. Like the Sedona desktop at Intel, this still-unnamed application examines the file, e-mail, article, or Web page you're currently reading and then recommends other files, e-mails, articles, or Web pages that may be of interest. "It watches and comes up with documents important to your situation," Rhodes says.

The agent, whose source material (the database of documents it draws from) is predefined by the user, can be used in three separate environments: the desktop, the wearable, and the Web. On the desktop, it canvasses your Emacs editor—running under Linux—and lists all potentially relevant documents just beneath the editor. The wearable version works in much the same way but is designed to consider your current real-world surroundings as well.

Eventually, the agent will recommend documents based on where you are, who you're talking to, and what time it is. The Web

Ink, and Smart Rooms

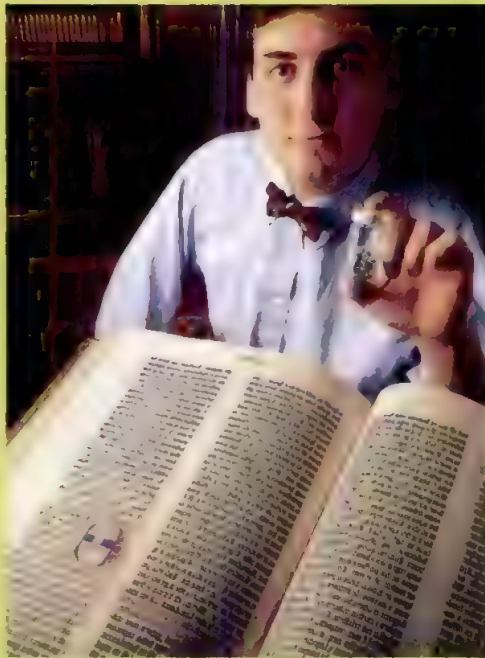
version seamlessly integrates with your browser. As with the WBI agent under development at IBM, it annotates each Web page with links to other pertinent documents. "They're like Post-It notes," says Rhodes. "Whenever it finds useful information for you, a little Post-It appears in the margins."

Kasbah, recently completed and deployed by a colleague of Rhodes, is an "automated classified ad system" that uses agents to buy and sell goods for you even if you're engaged in other tasks. If you're selling an audio CD, for instance, you simply tell the agent how to negotiate and find a buyer. "I have a *Grease* soundtrack CD that I don't like," says Rhodes. "So I asked the agent to offer it for \$12 initially, linearly ramp off the price, and stop at \$8 several months later. If it finds a buyer, then it sends me an e-mail." Using everything from Java to Perl to CGI script, other MIT researchers have coded agents that introduce people with similar interests, record Web-browsing habits, and recommend music.

In an effort to provide a cheaper, tractable alternative to the LCD, Media Lab's Joseph Jacobsen has created a kind of electronic ink—a polymer that you can spread onto any surface and set with your desired text using an electric field. "We don't cut displays from glass," says Jacobsen. "We print them."

Essentially, the ink consists of particles that are black on one side and white on the other. To form a letter or a number, an electric field beneath the polymer simply flips certain particles to black and others to white. The text remains intact once you remove the electric field, but you can erase or reset it at any time. Thus, any surface coated with the ink becomes a one-volume library, a book that's the New Testament one day and *Valley of the Dolls* the next. "We'll have commercial products in the marketplace within two years," says Jacobsen.

Roughly two decades from now, silicon-chip manufacturing will reach its physical limit. Transistors will fit into a single atom, and clock speeds will approach the speed of light. Because Moore's Law must one day cease to be true, researchers have long been exploring the possibility of a quantum computer—the only computing paradigm that could exponentially improve our current model. In such a machine, each bit would be represented by a quantum system—the magnetic spin of a nucleus, for instance.



MIT Media Lab's Joseph Jacobsen has created a kind of electronic ink that can turn any surface into a one-volume library—the Bible one day and *Lolita* the next.

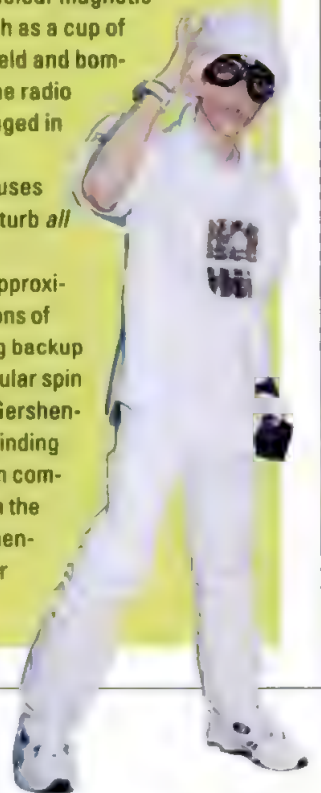
With a so-called qubit (short for *quantum bit*), an up-spin would be a 1 and a down-spin would be a 0. Whereas a classical bit (one governed by the laws of classical physics) holds either a 1 or a 0, a qubit can simultaneously hold both a 1 and a 0; according to the superposition principle of quantum mechanics, a quantum system can exist in all its possible states at once. With two qubits, you still have four possible values (00, 01, 10, 11), but you can store all four values concurrently. "An n -bit classical register stores n bits," says Gershenfeld, "but an n -bit quantum register stores 2^n bits."

The rub is that once a quantum system interacts with the classical world, it "decoheres" and collapses into one of its possible states. "If you ever look at a quantum computer," says Gershenfeld, "you break it." To wit, if you read an n -bit quantum register then it goes back to having n bits. Gershenfeld

and Isaac Chuang have solved this problem by creating a quantum computer that uses a very large number of atoms—not a single atom—for each qubit.

According to a process known as nuclear magnetic resonance spectroscopy, a liquid—such as a cup of coffee—is surrounded by a magnetic field and bombarded with radio-wave pulses. After the radio pulse interacts with the liquid, it is changed in a way that identifies the spin of various nuclei within the liquid. This change causes such nuclei to decohere but doesn't disturb *all* of the nuclei.

Since each qubit is represented by approximately 10^{23} nuclei, you can destroy trillions of nuclei and still have trillions of remaining backup copies. In this type of system, one particular spin configuration will always be dominant. Gershenfeld's prototype makes a calculation by finding that dominant configuration. "A quantum computer with 40 qubits could be bigger than the biggest classical computer," says Gershenfeld. The future of the personal computer could be in your cup of coffee.



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Wide Area Networks

Wide Area Network innovation and pricing will depend on the outcome

of today's telecommunications regulation battles.

By Frank J. Derfler, Jr.

PRICING, MARKETING, PACKAGING, AND regulation will drive the configuration of wide area networks (WANs) in 2001 and beyond—even more so than technology. Though the engineer and the accountant wrestle, and the accountant usually wins in today's planning sessions, the WAN planner of the future will need both skills in one brain.

You might think of the Internet or your intranet as a network of dedicated cables, but it's not. For a large part of the trip, your intranet bits probably share photon pipes comfortably with bits carrying the business data of many corporate and governmental networks. Backbone pipes are getting bigger, and in the next decade, cross-country bandwidth will be a commodity. You will have to work to get commodity pricing.

A corporate intranet, a corporate WAN, and even large parts of the Internet are high-level marketing and management abstractions. They're different ways of marketing the same bit-carrying connections. Communications service vendors use software-based features of network routers and switches to repackage bit-carrying capacity and sell it over and over again.

The picture of your network options in 2001 will emerge from the present battle over telecommunications regulation. If regulation wins, we'll be stuck with today's price schemes and we'll continue to hear only promises of innovative service and pricing. But if competition wins,

you'll need a committee, a calculator, and network-planning skills to find the best deals.

Today's classifications of carriers such as ISPs and LECs (local exchange carriers) won't mean much in 2001. The major difference will continue to be between companies that own local access cables and those that merely lease cables from the owners. This difference will last several years past 2001, until wireless access services grow throughout neighborhoods, make those copper access circuits obsolete, and break the local access bottleneck.

At this moment, the powerful regulated carriers, primarily RBOCs (Regional Bell Operating Companies), are winning the regulation battle by outmaneuvering the proponents of competition. These regulated carriers simultaneously charm Wall Street with promises of earnings growth, cow state public-utility commissions and the FCC with reports of financial problems, and alarm public factions with warnings of loss of service and huge price increases. Their court activities defy simple description. The outlook for the delivery of innovative WAN services from the regulated carriers or their unregulated subsidiaries is dim. Generally, it's fair to say they talk about innovation and practice stagnation.

Innovation in the WAN market in 2001

and beyond will come from special contracts with carriers using shared frame-relay networks to displace leased lines and locally provided routers, firewalls, and intranet servers. The contracts deliver services outside regulated tariffs. The best WAN plan in the next decade will be to use customized frame-relay services to drive around the dead zone of regulation. Today, we call this emerging business *VPN provisioning* or *outsourcing*. In 2001, it will be the common way of doing things.

In 2001... VPN provisioning is the common way of doing things.

Today, you can save 20 to 30 percent of your annual leased-line connection costs by contracting for replacement frame-relay services. By the millennium, the savings should be higher, because the real unregulated costs will be much lower. Public data networks delivering a menu of services are clearly the preferred alternative for year 2001 WANs.

But there's a long list of catches. In today's model, leased-line pricing is distance-sensitive and traffic-insensitive. Public data networks are just the opposite, so you'll have a whole different traffic model to consider. Today, when you create your own WAN with leased lines and your own routers, you know what you pay for options such as added security or management. When you buy a package of services, you get a bottom-line quote with little detail broken out. You will trade today's up-front equipment-purchase costs for higher monthly charges. Comparing different bids for integrated services will involve analyzing the offerings carefully and then weighing the value of some arcane differences.

The WAN 2001 we envision is a linear progression from today's. Differences in magnitude will come only from unexpected breakthroughs provided by innovative, competitive carriers.

WAN Watchwords

LEC Competitive local exchange carrier. This category includes companies that compete with the franchised local telephone companies. Carriers such as AT&T compete as LECs in some areas, as do power companies and many others.

Frame relay A data-carrier technology that uses shared switches and wide-bandwidth connections. For a monthly fee, a frame-relay service offers reliability, flexibility, and economy.

ISP Internet service provider. The number is small—there are thousands in the U.S.—typically lease

circuits from other carriers and add features such as e-mail as well as Web site hosting and domain naming services.

IXC Interexchange carrier, a long-distance carrier that moves traffic between LECs.

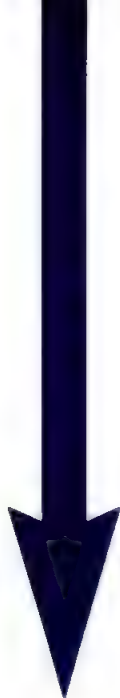
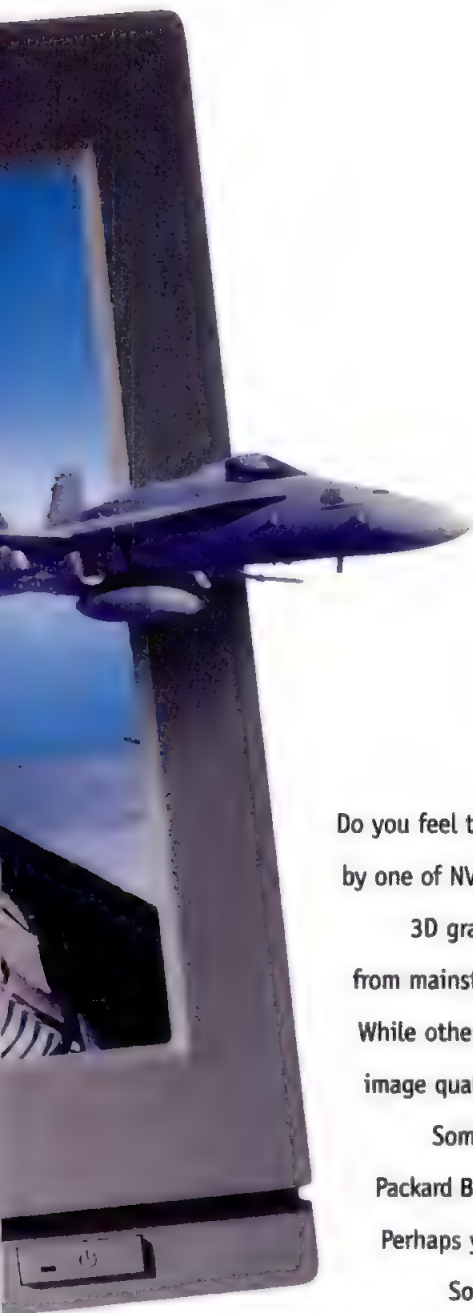
LEC Local exchange carrier. There are more than 100 such franchised local telephone companies in the U.S.; the biggest are the RBOCs plus GTE.

RBOC Regional Bell Operating Company, any one of the LECs spun off from the original AT&T Bell system.

VPN Virtual private network, a network that seems to be dedicated to one user but really rides over shared public services.



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Wireless Communications

Wireless connectivity will pose a major challenge to cable modems and digital subscriber lines, beating wired-in copper much of the time.

By Frank J. Derfler, Jr.

HISTORIANS WILL LABEL THE YEARS 1995 to 2005 the Decade of Wireless.

That's because it's a lot easier to put an antenna the size of a ping-pong paddle atop a pole than it is to trench in or string up cable to dozens of buildings. Similarly, it's a lot easier to point an antenna the size of a deck of cards at a satellite than it is to install distribution cables throughout. So it's easy to pick wireless as the come-from-behind winner of the connectivity contest in 2001 and beyond.

Several kinds of wireless systems will significantly enrich our connection options in the next decade. Will wireless displace your cable modem and digital subscriber line (DSL)? Nothing is certain, but unless people lose their feet and wheels, wireless portability will beat wired-in copper much of the time. The wireless revolution is happening now, but it won't peak until the years 2003 to 2005.

The announced goal of AT&T Wireless, Hughes Network Systems, and other companies is to provide one telephone-like device for use in the office, around the campus, and on the road. In doing so, innovative companies will have to use different wireless services to solve two distinct problems: the "last mile" and the "roaming portable."

The last mile of a communications connection to any location is fraught with problems, many of them regulatory and legal. But the technological problems of connecting desktops in buildings to high-speed services a mile or two away are also big challenges. Cable modems are getting good press right now as last-mile solutions, but at the end of 1997, there were only about 100,000 cable modems installed in the U.S. Even 300,000 by the end of 1998 will hardly meet the needs of users.

Wireless systems provide a nearly

ideal solution to the last-mile problem. Two technologies are available. The multichannel multipoint distribution system (MMDS) is the so-called wireless cable that operates in the 2-GHz band. The local multipoint distribution service (LMDS) or wireless modem operates in a huge slice of extremely high frequencies between 26 GHz and 30 GHz.

LMDS is the most likely winner as the access technology for 2001 and beyond, as are the companies that spent \$300 million last February to buy FCC licenses in this spectrum. Note that LMDS takes care of the last mile and campuswide or neighborhood roamers. Other 2001-and-beyond solutions will take care of wider roamers.

Several acronym-laden connection tech-

nologies compete in the wireless digital connection market, but data throughput is about what we got from 14.4 analog modems several years ago. The goal of future third-generation cellular systems is to

connect large numbers of moving customers at 64 Kbps.

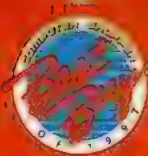
The higher data rates and innovative services for roaming communicators will come from low earth orbit (LEO) satellite systems. LEO systems have been doing store-and-forward communications—first for military and intelligence agencies, and second for container freight shippers—since the 1980s. But real-time relays and large ground gateway services will make the difference.

Motorola's Iridium was the first of the modern LEO systems to get off the ground, and as of this writing, it has 51 satellites in orbit. Celestri, Motorola's follow-up system, will be a blend of high-orbiting, high-capacity satellites and low-orbiting, readily available connections. Two competitors, Globalstar and Teledesic, each put up a LEO test satellite in February. Globalstar was founded by Loral Space & Communications and Qualcomm, a strong communications-technology company. Teledesic is backed by Bill Gates and Craig McCaw and run by The Boeing Company.

Any and all of these systems will bypass wired connections, and competition and the servicing of roaming customers in 2001 will lead to aggressive pricing with complex menus of satellite services. The sophisticated gateways planned by the satellite companies should make it easy to forge a seamless integration with terrestrial wireless systems like LMDS. Abundant wireless data connections will drive many commercial and social changes in the next decade.

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200MHz Pentium Pro**	32MB	32MB	8X	10/100	\$3295.00	96899

*Rack model **Hot plug rack model



Proliant 2500 and 2500R Series

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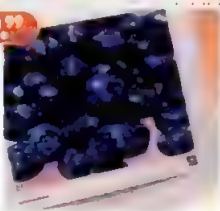
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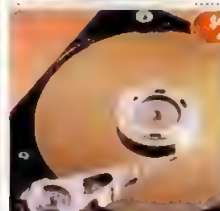
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2010

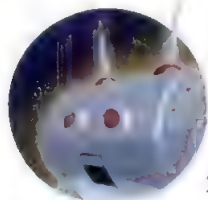
A DAY IN THE LIFE

IN THE
NEW
MILLENNIUM

WHAT WILL PCs LOOK LIKE IN THE YEAR 2010?
How fast will they be? And what will they do?

Andy Grove, Intel's chairman, once said that *fast* means that whatever happens happens in the blink of your eye. Even as today's PC approaches 500 MHz, anything other than the simplest tasks take longer than that—long enough to interrupt your concentration.

Come 2010, most things will happen in the blink of an eye, and it won't matter if the data is on your hard disk, on the network in your building, or on the other side of the globe. Even when you're connected wirelessly, on the road or in a plane, everything will happen just about instantly.



In this special pullout section, we offer a highly personal view of what life will be like in the year 2010. What matters most won't be the megahertz rating of your computer's CPU or the size of the box (though it will be smaller, for sure) but what your PC can do for you. Expect the computer and its agents to automate many of the tasks you now do manually. In other words, the PC will be a real time-saver and even a brain amplifier.—*Bill Howard*

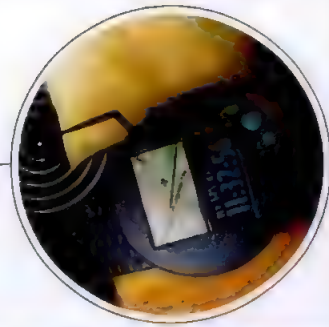
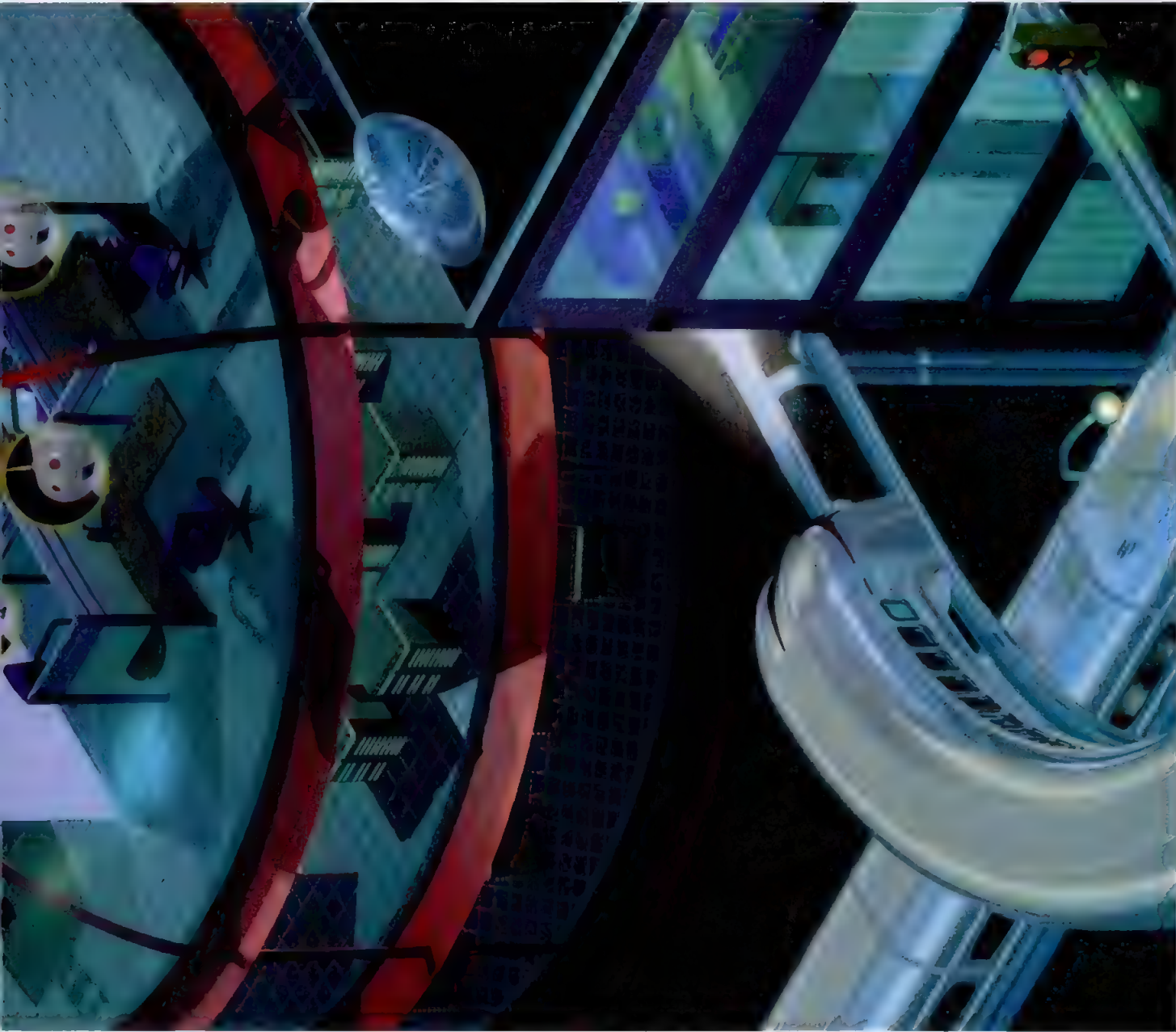
Turn the page for a glimpse of how you might be living in 2010. ➡





...Back to Work

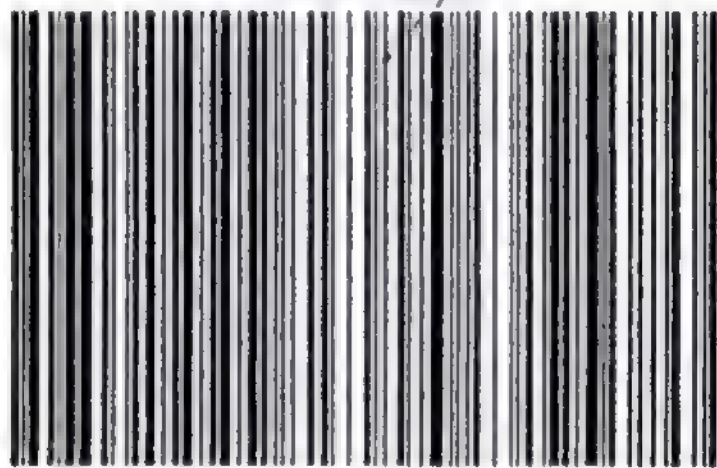
All the system-unit electronics for your office PC now fit inside the flat-panel monitor, making year 2010 PCs little more obtrusive than phones have been in the last decade. PCs are a combination of tiny desktops with local intelligence, network PCs with server-based smarts, and ultralight portables. Every display has a running news ticker and an inset TV news feed beaming only news of interest to you and your company. Voice input works well enough to challenge keyboards. Much routine PC work, such as finding mutually free meeting times, is done by agents. Walkaround cordless phone/PDAs keep you in touch throughout the building or corporate campus; off-site they become cellular phones. Private-office and conference-room videoconferencing reduces the need for marginal business trips.



1. Follow instructions on the other side

Back

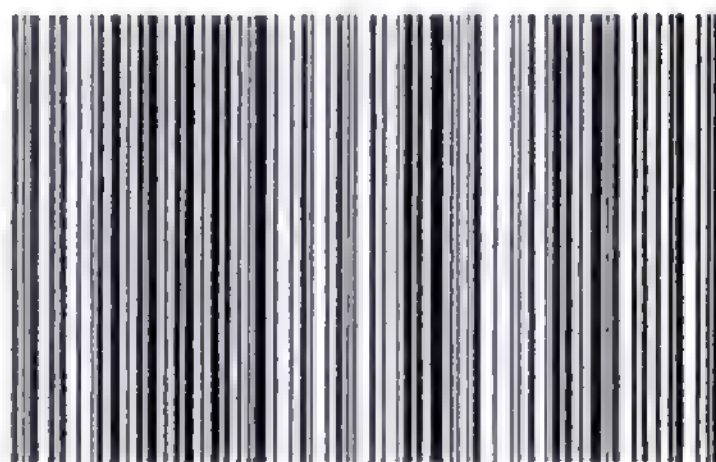
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Inverted Back

1. Follow instructions on the other side

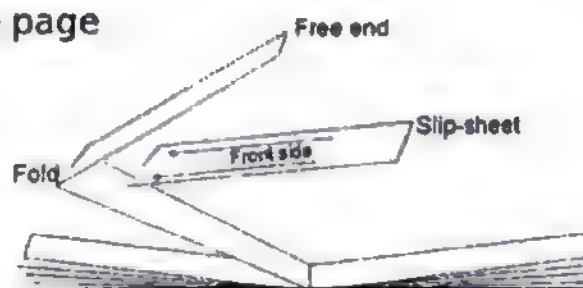
Folded edge of the page



GbsSlipSheet-001

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Open the foldout page

2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

3. Slice the folded edge

4. Close the page and slip-sheet

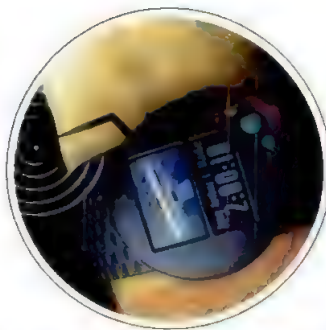
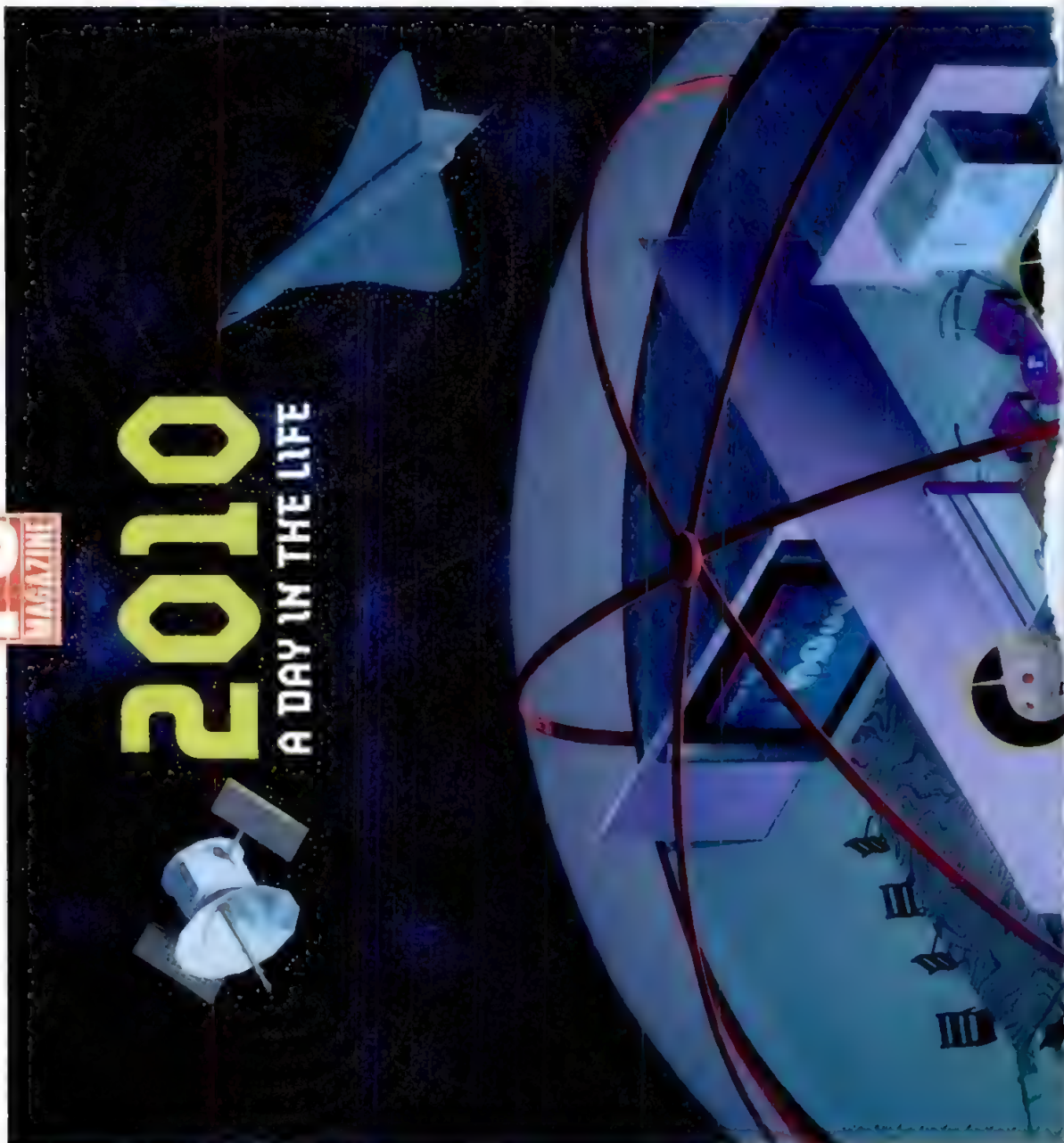


Foldout slip-sheet



2010

A DAY IN THE LIFE



...And Beyond

Even up in the air at supersonic speeds, you can stay in touch if you want. Every seat back has a built-in flat-panel computing/entertainment display, and you may want to use it because the ever-shrinking seat pitch makes it all but impossible to use regular notebook computers when the guy in front reclines his seat. For those back on the ground, thousands of orbiting satellites provide more speed at lower cost than today's wired connections—a boon for travelers anywhere and an asset for developing countries that could never afford to wire every home and business.



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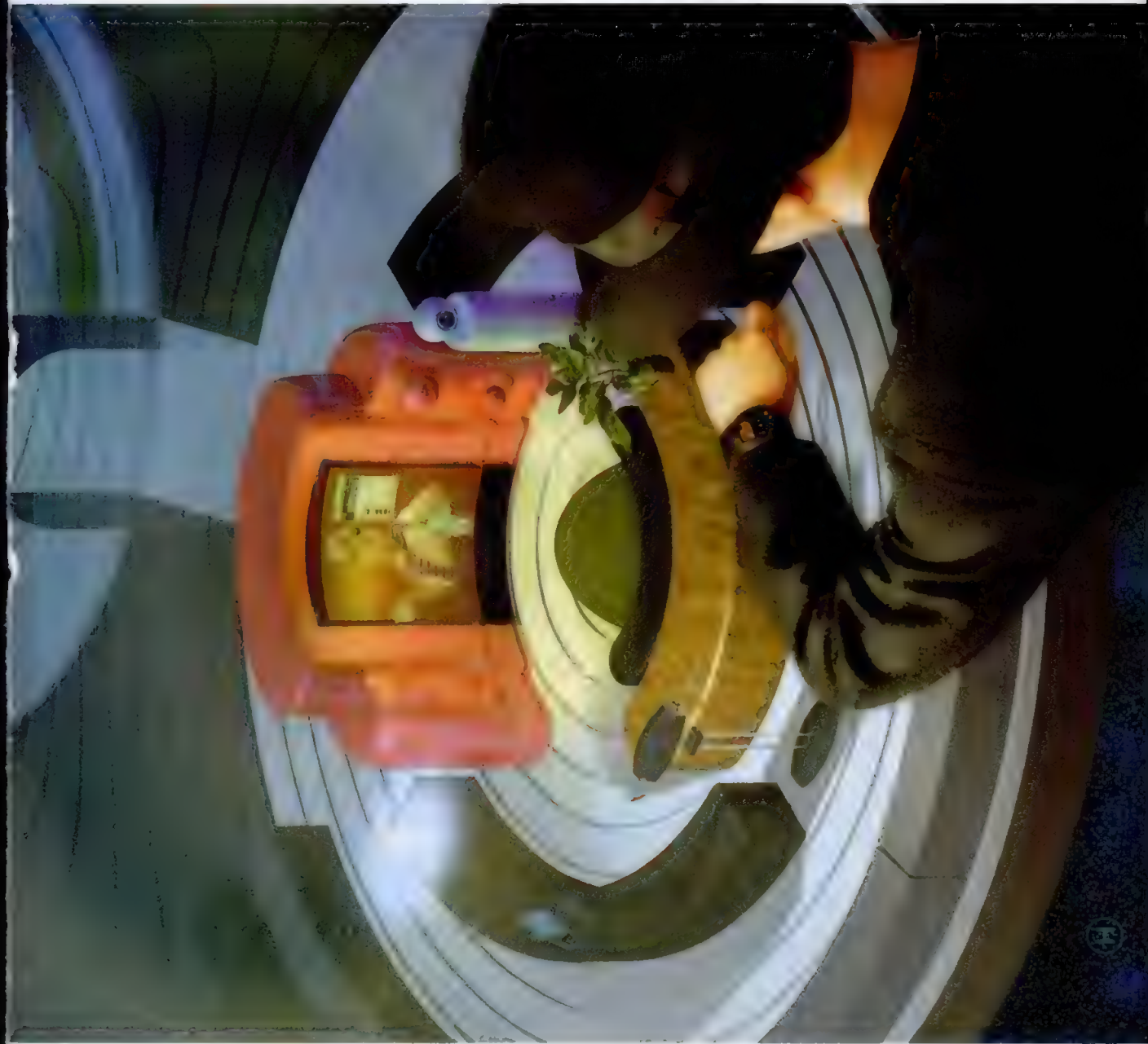


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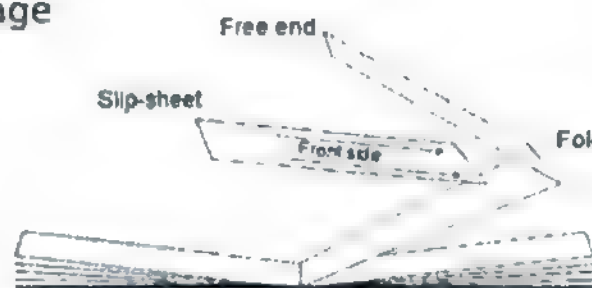
The year is 2010, and it's straight out of *Dick Tracy*. That wristwatch you're wearing really is a two-way communicator: a phone, a pager, and an appointment calendar, and it even displays video.



Start at Home...

Is that a TV or a computer you're looking at? In 2010, they're one and the same. Flat-panel monitors are in most rooms of the house, all connected to the Internet and to an "information furnace" that controls heat, lights, audio and video, and security. TV-quality videoconferencing lets you work better from home and lets the grandparents two time zones away see the kids. Cameras outside tell you visitors are at the door, and sensors warn you if the kids stray near the poison ivy. Inside, all this information travels acceptably well across existing phone lines or AC wires or via radio frequency. Your input? A keyboard, if you wish, but voice commands work well too.

1. Open the foldout page
2. Insert this sheet with
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 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Foldout slip-sheet



Inverted Foldout slip-sheet

Folded edge of the page

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2. Insert this sheet with

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2. Arrow pointing to the fold

3. Slice the folded edge

4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



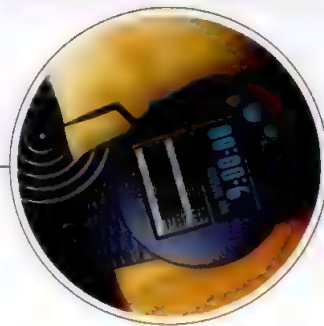
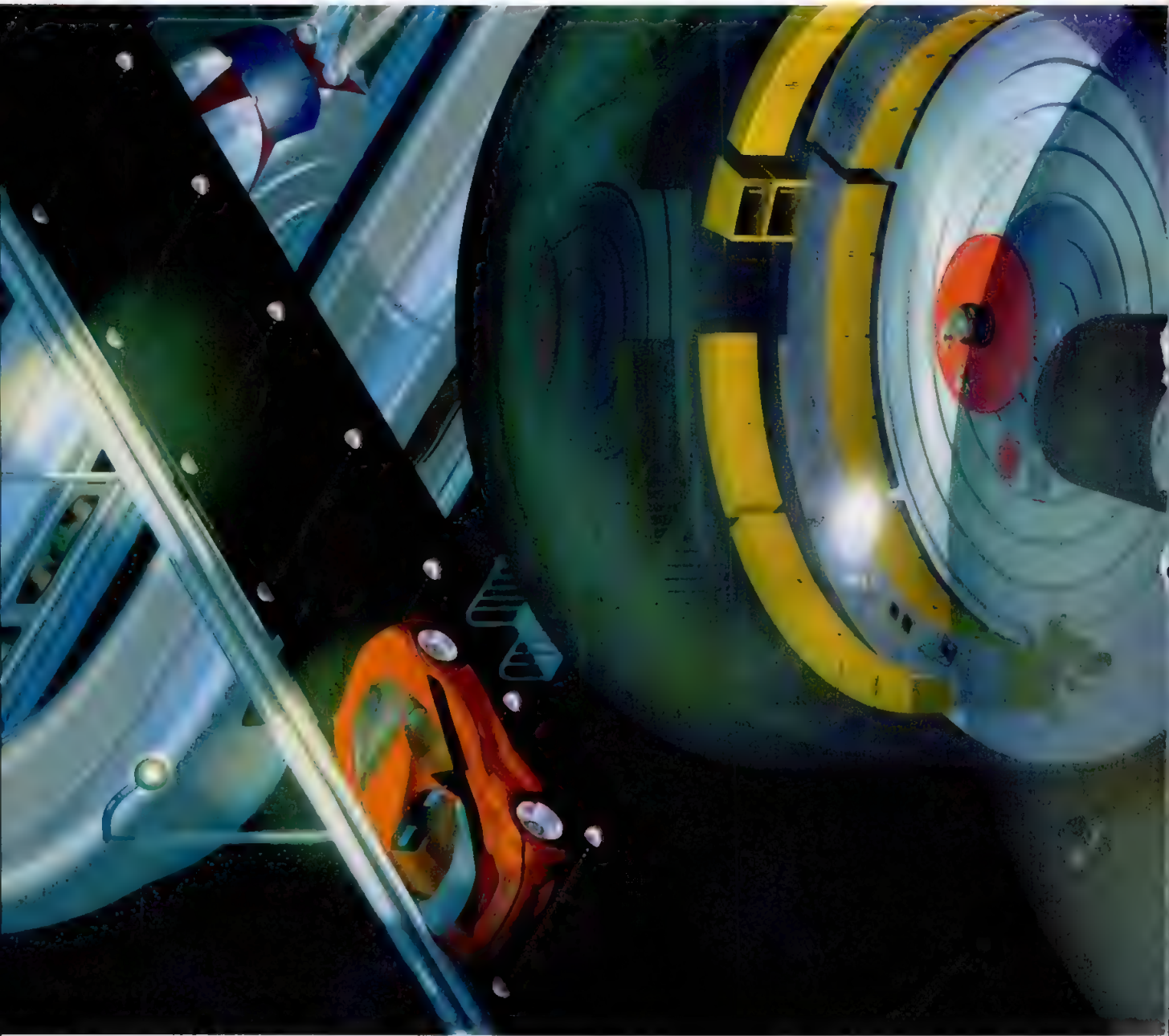
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Back

1. Follow instructions on the other side

...Hit the Road

In your hotel room, the TV in the armoire is your gateway to the Internet and your company's internal network. A wireless keyboard lets you work from the bed or an easy chair. A videoconferencing camera keeps you in touch with the office and family. When you bring your own laptop, the hotel provides seamless high-speed connections to the outside world. Best of all, the connections are no longer hidden in the dust bunnies living under the bed. But nonsmoking rooms still smell smoky. Technology can't solve every problem.



...Go to Work

Driving to work, you can read the paper, put on makeup, yak on the cell phone, or use your laptop—just as safely and conveniently as big-city train or bus commuters. A combination of expressway sensors, global-positioning systems, and in-car computers do the driving for you on limited-access roadways. The biggest hurdle turned out to be not technical but legal concerns over liability. Car PCs provide door-to-door driving instructions, route you around accident sites, and find restaurants and book



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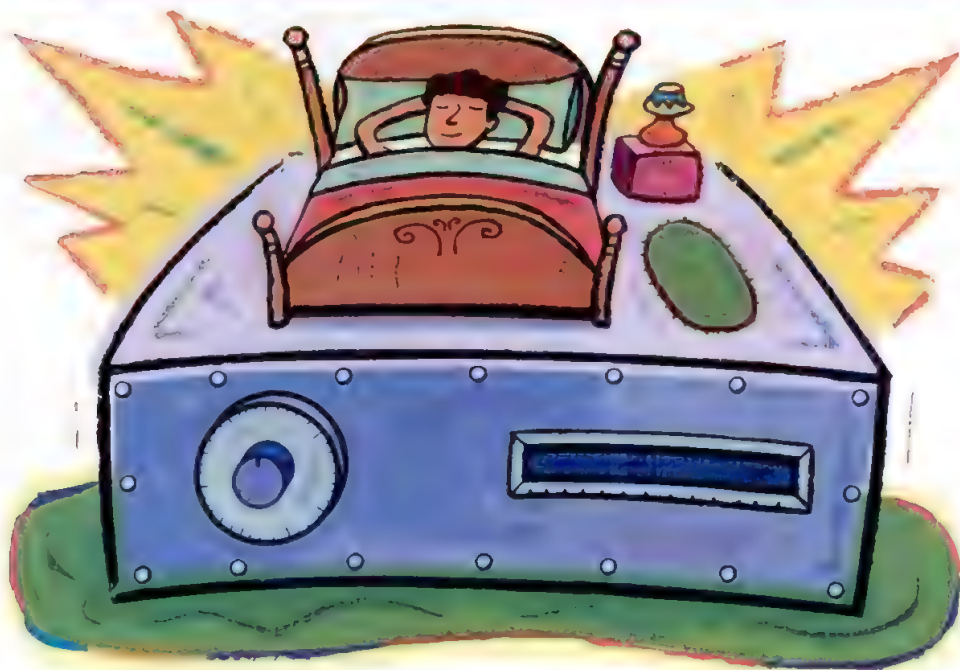
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Net Tools



The Drive to *Protect*

Today's backup drives are better equipped than ever to handle your network's growing needs.

By Steve Rigney

PCs are getting cheaper every day, but one cold fact remains: Your data is increasing in value. As companies develop new means of targeting and keeping customers in a changing economy, choosing the best backup drive is a linchpin of any strategy for safeguarding your valuable data—whether it's on networked client PCs or the server itself.

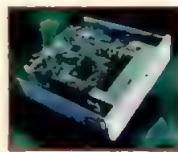
For both capacity and features such as backup scheduling, the medium that almost invariably comes to mind is tape. Most other media don't

rate, particularly when you factor in the need for larger networks to run under NetWare or Windows NT Server. Even the workgroup networked via Windows 95 in a peer-to-peer setup will need more than, say, an Iomega Jaz Drive dragged exhaustedly from cube to cube.

In this roundup, we focus on tape devices designed to protect small peer-to-peer and medium-size server-based workgroups. Our mix includes the less-expensive small workgroup solution, the Travan, and the higher-end digital audio tape (DAT) drives. Though these drives adhere to

INSIDE

TAPE AT 11:00?...After quitting time, LAN administrators back up servers and clients alike. But though tape is preferred, choosing between Travan and DAT is only your first decision. See contributing editor Steve Rigney's review of seven drives in both of these categories.



ALL OR NOTHING? It doesn't have to be—even when you're assigning rights under Windows NT Server. In Mission Critical Software's Enterprise Administrator 4.5, Steve Rigney sees a handy tool for granting users limited rights. *Page 233.*

MANAGERIAL HUB: Steve Rigney may seem the hub of this issue's Net Tools, but the real one is his reviewed HP 10Base-T Hub 12M, which deftly alerts you to hub-related network problems and then tells you what to do about them. *Page 233.*

TWO-WAY STREET: Contributor Daniel B. Levine finds Miramar Systems' PC MacLAN 6.1 useful for exchanging files between Macintosh and Windows NT users. *Page 234.*



PAST THE HOURGLASS: The I2 Project is building tomorrow's Internet. Check out contributor Stephanie Izarek's big-picture view. *Page 239.*

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archive of networking
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Net Tools

TAPE BACKUP

standards, they offer varying options and features as well as some noteworthy bundled software.

All the Travan drives in this roundup can handle up to 8GB of data with compression, which should be enough for small networks of 5 to 10 PCs. But the DAT models here can hold up to 24GB of data—after you spend more than \$1,000 just for the drive. Travans, by comparison, cost less than \$1,000 even with client and server backup software included.

The difference begins to even out when you buy media. Travan QIC cartridges cost about \$25 each, or \$3.13 cents per gigabyte. A 4-mm DAT costs about \$10, or 42 cents per gigabyte.

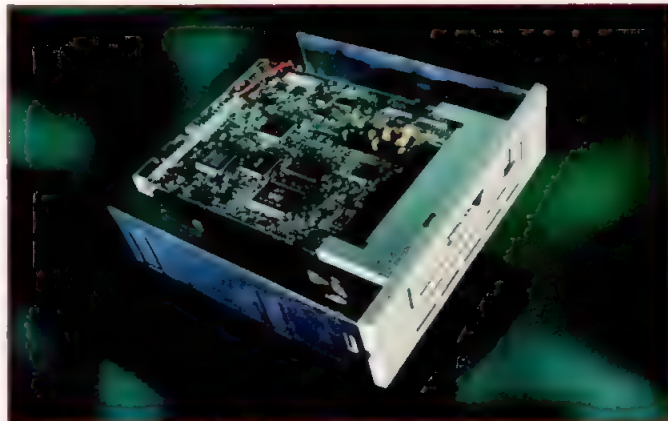
We filtered our selection by focusing on those products that conform to standards and come from their original manufacturers. With this filter in hand, we earmarked four Travan and three DAT devices. The Travan models are the Aiwa Travan TD-8001 NS8, the HP SureStore T4e, the Seagate TapeStor Travan NS8, and the Tecmar OfficeBackup Workstation. In the DAT category, we tested the HP SureStore DAT 24/e, the Seagate TapeStor DAT 24, and the Sony WAN-Backer 9000. All the Travan devices meet the TR4 or Network Series (NS) specification. And similarly, the DAT devices here comply with the Digital Data Storage-3 (DDS-3) specification.

A TRAVAN TRADITION

Travan, a tape specification developed by Imation, is part of the Quarter Inch Cartridge (QIC) standard that has been around for years. Like QIC, Travan drives are broken down into categories such as TR3 and TR4. These categories actually correlate with a QIC cartridge format. Individual formats are based on the length of the tape, how much data the tape can hold, and how the data is written to the media.

In a nutshell, the Travan specification extends the length of the normal QIC tapes to let them hold more data. The standard QIC 0.315-inch-wide tape, for example, is 400 feet long and has a native (precompression) capacity of 2GB. The TR4 cartridge, the newest Travan specification, uses standard 0.315-inch tape but increases its length to 740 feet; TR4 cartridges can hold up to 4GB of data without compression. With compression, a single TR4 cartridge can hold up to 8GB.

In an effort to make Travan drives more attractive and useful for small networks, Imation later developed the NS8 specification. NS8 uses the same QIC cartridge as the TR4 specification, but in order to have its NS8 stamp of approval, the device must also include internal hardware compression and read-while-write verification. The latter avoids the need for a compare procedure following backup. These enhancements provide



LEAN AND MEAN: The Aiwa Travan TD-8001 NS8 may not come with many extras, but it truly excels in performance.

increased performance and capacity, two important requirements for a small network. All the Travan drives in this roundup, except for the HP SureStore T4e, adhere to NS8.

What's the appeal of Travan beside the greater capacity of DAT? Travan keeps its following for one important reason: price. Most small networks, after all, are on a tight budget; spending much more than \$500 for a backup solution is often out of the question.

On the other side of the argument is bundled software. Travan devices are usually bundled with software that runs on Windows 95 and Windows NT Workstation, but not Windows NT Server or NetWare. And with client PCs coming standard with 4GB and larger hard disks, 8GB of capacity does not seem like a lot. This makes most Travan packages appropriate only for small peer-to-peer networks of five to ten PCs, and for a server-centric workgroup, you should look at the DAT backupgroup packages reviewed in this feature.

The Travan devices we looked at ranged in price and features from the \$299 internal Aiwa Travan TD-8001 NS8 to the \$710 external Tecmar OfficeBackup Workstation. Except for the TD-8001, all the Travan packages offered a turnkey solution complete with software that lets you back up your Windows 95 and Windows NT-based workstations. HP and Tecmar also offer packages that include software for protecting NetWare- and Windows NT-based servers. Note that the other

EDITORS' CHOICE

• Nobody's perfect



The Travan and DAT drives we reviewed are clearly mixed bags—leaving no solution in either category to earn our nod for Editors' Choice.

Hewlett-Packard's Travan model, the HP SureStore T4e, does well with the extras, such as its notification and diagnostic software, but its performance is slow. Both the Aiwa TD-8001 NS8 and the Tecmar OfficeBackup Workstation stood out in testing. We can grant Tecmar an honorable mention for the best NS8 package for both client and server backup, but this \$710 solution is too costly not to have adequate documentation and diagnostic software.

Among the DAT drives, even an honorable mention would be a stretch.

Hewlett-Packard's unit, the HP SureStore DAT 24/e, initially seemed a sure thing with its backup speed and warranty. And the Seagate TapeStor DAT 24 is bolstered by the inclusion of Backup Exec Single Server Edition.

Neither solution, however, offers all-around excellence. For Hewlett-Packard, it's the inappropriate bundling of client-only backup software. For Seagate, even if slow performance wouldn't trouble you on after-hours backups, the DOS-based diagnostic software and two-day replacement probably would as a server backup solution.

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drives permit backup of NetWare and Windows NT servers across the network, but this is a slower and less fault-tolerant solution. In addition, whereas the software bundled with the Travan drives typically can work with any other drive, the Colorado Backup included with both of the HP drives is specific to HP-made models.

If you're looking for a turnkey package that will let you back up both client and server PCs,

DAT'S THE TICKET

With a sustained rate of 770 KBps and a total capacity of 8GB, Travan drives are a good choice for both desktop PCs and small workgroups. But for larger networks that need better speed and greater capacity, a DAT drive may be your better choice. Like Travans, DATs are broken down into different categories based on the length

of the tapes, as well as speed and capacity. The newest specification, DDS-3, supports storage of up to 12GB of uncompressed data (up to 24GB compressed) and operation at sustained transfer rates of 1.2 MBps. Need more? Autoloader devices are available for holding, and automatically feeding, multiple tapes. For a four-tape DAT autoloader, expect to pay about \$2,400—plus some

\$700 to add this feature to your software.

As speed and capacity increase, so does price. The DAT products in this roundup of products range from \$1,569 for the Seagate TapeStor DAT 24 to \$2,639 for the Sony WANBacker 9000.

Another advantage to DDS-3 drives is their interoperability. Almost every storage management package, including ARCserve, Legato NetWorker, Seagate Backup Exec, and Stac

Net Tools

TAPE BACKUP

Replica will work with the DAT drives in this roundup; the only exception is the version of Replica included with HP's Travan model,

which works only with its bundled drive. Thus, it's more common for a network administrator to purchase a DAT device without software—springing an extra \$695 (list), for example, to buy the Single-Server Edition of Backup Exec. One caveat here is that none of the three DAT vendors provided sufficient information on installing their drives with the reigning backup applications.

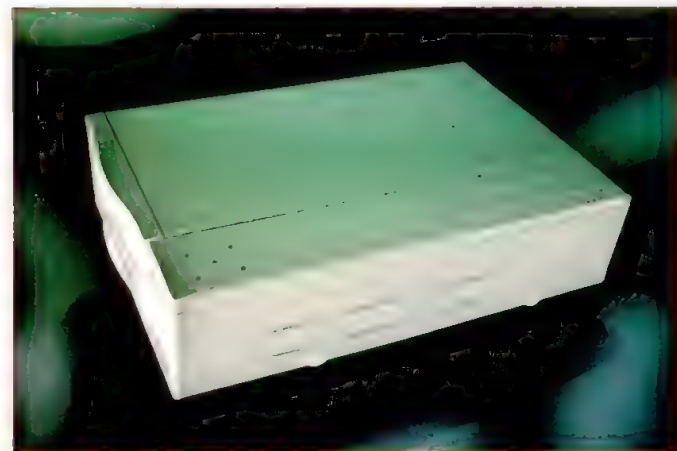
On our tests, we found that the SureStore provides high performance at a reasonable price, but it doesn't bundle any software for server-based backup. The WANBacker is also a fast performer, but it's more expensive than the others. The TapeStor proved to be the slower contender, but it offers a reasonable price and will provide server-based software by the time you read this story. From there, it comes down to your own individual needs.

Travan Tape Drives

Aiwa Travan TD-8001 NS8

All reviews by Steve Rigney

The least expensive product in this roundup, the Aiwa Travan TD-8001 NS8 (\$299 list) is a bare-bones package that nonetheless is well designed and performs satisfactorily. We tested an internal SCSI NS8 model that came without tapes, cables, or software yet had some useful features such as five variable transfer rates—compared with one to



GOOD AND PLENTY: Tecmar OfficeBackup Workstation comes with all the necessary cables as well as backup software.

HP's SureStore T4e at first seems best to fill the bill. Unfortunately, it's not an NS8 device and didn't perform well on our tests. The second-best package is Tecmar's, but its options are expensive. Aiwa's TD-8001 offers good performance but no extras, and Seagate's TapeStor is relatively slow and includes only software for use on client PCs. Nevertheless, all of the Travan packages we tested make perfectly decent solutions for small workgroups.

Backup Hardware at a Glance

	Imega Jaz, SyQuest SparQ, and other removable disk-based drives	Travan TR4	DAT DDS-3	High-end tape-based drives (AIT, DLT-4000, DLT-7000, Mammoth)	Online backup services
Description	Removable floppy disk	QIC (quarter-inch cartridge) tape	4-mm cartridge tape	8-mm or 0.5-inch tape	Software sends your compressed data to a third-party off-site installation via the Internet
Cost of drive	\$200–\$350	\$300	\$1,000	\$4,000, \$8,000*	None
Cost of media	\$40–\$120	\$25	\$10	\$10–\$100	Monthly charges vary
Uncompressed capacity	1GB	4GB	12GB	20GB–35GB	N/A
Compressed capacity	2GB	8GB	24GB	40GB–70GB	N/A
Pros	Inexpensive hardware, easy to use and transport, appears like another hard disk in your PC, easy access to individual files.	Inexpensive device; works with all client and most server operating systems	Inexpensive media with fairly high capacity, works with almost every network operating system and backup software application.	High-capacity media, high sustained transfer rates, works with most major software backup applications.	Low-cost subscription, enables you to back up or restore from any Internet connection, keeps data off-site and secure.
Cons	Expensive media with relatively low capacity, does not include software for unattended backup, does not work with all network operating systems	Fairly expensive media, provides only up to 8GB of storage; not supported by all server-based backup software	Fairly expensive drives	Expensive drives	Requires an Internet connection, too slow for transferring a lot of data every day

* DLT-7000. N/A—Not applicable. Storage capacity is not an issue with online services.

three for the other products. If you're looking for a turnkey solution, the TD-8001 isn't for you. But if you already have your backup software, or don't mind purchasing it separately and forgoing decent manuals and diagnostic software, this product is worthy of your consideration.

When we opened the TD-8001 package, all we found was an internal drive and a small,

folded sheet that served as the manual. Though it clearly explained how to change the SCSI IDs and covered the basics of termination, it didn't mention anything about backup software or provide any troubleshooting tips. We had to guess what software the drive would work with. (We used the vendor-recommended Seagate Backup Exec for Windows 95 on our tests.) Unlike the other com-

panies, Aiwa doesn't offer optional packages that include backup software; you'll have to purchase that elsewhere.

The unit came in a close second on our backup tests of Travan drives and took first place during the restore. The relatively high transfer rate has a lot to do with these results. Most of the other NS8 products have a transfer rate of 600 KBps, compared with 770

SUMMARY OF FEATURES

See www.pcmag.com for interactive views

Tape Backup Drives

■ YES ■ NO

Products listed in review order

	TRAVAN	DAT	Aiwa Travan TD-8001 NS8	HP SureStore T4e	Seagate TapeStor Travan NS8	Tecmar OfficeBackup Workstation	HP SureStore DAT 24/6	Seagate TapeStor DAT 24	Sony WANBacker 9000
List price, internal/external configurations			\$299 / N/A	N/A / \$559	\$309 / N/A	\$585 / \$710	N/A / \$1,673	\$1,159 / N/A	\$2,369 / \$2,639
Drive standards supported			NS8	TR4	NS8	NS8	DDS-3	DDS-3	DDS-3
Media supported			TR4, TR3, TR2, TR1	TR4, TR3, TR2, TR1	TR4, TR3, TR2, TR1	TR4, TR3, TR2, TR1	DDS-3, DDS-2, DDS-1	DDS-3, DDS-2, DDS-1	DDS-3, DDS-2, DDS-1
Drive dimensions (HWD, in inches)			1.0 x 4.0 x 6.0	2.5 x 11.4 x 7.1	1.0 x 3.5 x 6.0	2.4 x 6.5 x 10.0 (external version)	4.6 x 3.7 x 8.7	1.5 x 3.5 (or 5.25) x 6.0	1.6 x 4.0 x 5.8 (external version)
Mounting kit included for internal drive			■	N/A	■	■	N/A	■	■
Includes backup software/cable for external drive			■ / N/A	■ ■	■ / N/A	■ ■	■ ■	■ / N/A	■ ■
Uncompressed/compressed capacity			4GB / 8GB	4GB / 8GB	4GB / 8GB	4GB / 8GB	12GB / 24GB	12GB / 24GB	12GB / 24GB
Sustained native transfer rate			770 KBps	600 KBps	600 KBps	600 KBps	1 MBps	1.1 MBps	1.2 MBps
Vendor-reported access time (inches per second)			118	120	45	110	40	45	45
Warranty			2 years	2 years	2 years	2 years	3 years	2 years	2 years
Product replacement policy			None	2 years	None	None	3 years	None	1 year

N/A—Not applicable. The product does not come in this configuration.

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KBps for the TD-8001.

Another explanation for the drive's excellent performance is its five-level, variable transfer rate. Variable rates let the drive speed up or slow down, based on the PC's activity. If the drive can't slow down when the PC is busy, there's a higher chance for errors. These errors force the drive to retry the copy and slow down the job time. Variable rates aren't unique, but the next-best product in this regard, the TapeStor, provides only three levels.

Because the drive didn't include adequate documentation nor any drivers for Windows 95, Windows NT, or NetWare, it took us a little longer to set up. Likewise, the jumpers on our test drive were not configured the way the manual stated they should be, which only added to the confusion. To its credit, the drive is already designed to fit into a 5.25-inch slot, so

it requires no mounting kit.

Aiwa Travan TD-8001 NS8. List price: \$299. Aiwa America Inc., Irvine, CA; 714-862-0200; fax, 714-862-0213; www.aiwa.com. Choose 905 at www.pcmag.com/infolink.

HP SureStore T4e

The HP SureStore T4e is the only Travan product in this roundup that includes software to back up both client PCs and NetWare or Windows NT servers. The package also offers the best diagnostic software; it's the only product besides the HP SureStore DAT 24/e with notification software that can send alerts to any SNMP-based console. On the downside, the SureStore is certified only as a TR4 device

Net Tools

TAPE BACKUP

which, for test purposes, means compression in software rather than hardware; the other products are NS8 devices. The difference

gave the drive a last-place backup score on our tests. Nevertheless, if you want a complete turnkey solution and care little about backup speed, for a Windows NT- or NetWare-based network, the SureStore is the most complete Travan package we tested.

With a list price of \$559, the SureStore is the less expensive of the two external Travan models we reviewed, and it has a lot to offer. In addition to a SCSI TR4 drive, the package includes a SCSI cable and terminator, TR4 cartridge, two types of backup software, and notification and diagnostics utilities. The unit is easy to install; the manual walks you

BENCHMARK TESTS

Travan/DAT Backup Drives



It doesn't pay to be slow in implementing technology. The HP SureStore T4e that we tested, a Travan model without the compression afforded by the NS8 standard, fell behind on our backup tests. The DAT drives, however, came in as a pack.

What the Numbers Mean

Hardware-based compression, a key function of the newer NS8 standard (found in all the Travan drives except Hewlett-Packard's), proved to be the chief determinant on our tests. The drives performed similarly on the backup tests, except for the HP SureStore T4e, which we tested with no compression.

Owing to the governing DDS-3 standard for data compression in DAT drives, these units performed similarly to one another on our backup tests, although the Seagate Scorpion 24 DAT drive lagged behind HP's SureStore DAT 24/e with a 17 percent slower rate.

But on our restore tests, we were puzzled by the Seagate TapeStor Travan NS8's sluggish results. This drive includes a technology the vendor calls FastSense. It theoretically starts at maximum speed, but if it senses that the data's destination is unable to match the 500-KBps (or 1-MBps compressed) maximum transfer rate, it steps down the tape drive speed. This prevents underwrites, letting the tape feed through without starts and stops. The result is better performance and, over time, less wear and tear on the tape. Although our test-bed should easily have been able to handle 500 KBps, the TapeStor seemed to slow down to its minimum speed of 275 KBps. We were unable to resolve the problem despite working with Seagate.

How We Tested

To test the performance of the Travan and DAT drives in this roundup, we performed a backup of a mix of applications and data

files and then measured the total time. Subsequently, for each drive, we timed a restore of the same data to its original location.

For the Travan tests, we used Windows 95 (OSR 2) for the operating system and Seagate Backup Exec for Windows 95 2.0b for backing up the data. All Travan drives tested were SCSI-based, running off the AMD PCI SCSI chip. We used a similar data set for both Travan and DAT drives, except for operating system files. The Travan data set had a full Windows 95 installation including Internet Explorer and additional applications—for a total of 330MB.

For the DAT tests, we used Windows NT 4.0's backup utility with all drives. Our server was a HP Vectra Pentium 150 with 32MB RAM and a 1.6GB hard disk. Each DAT drive was connected via the built-in AMD PCI SCSI chip. The data set included a copy of the base Windows NT OS installation—for a total of 280MB.

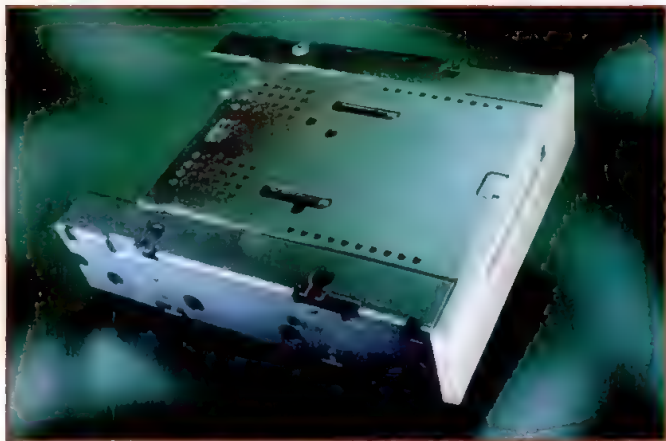
The data sets we used for the DAT drives differed from those used for the Travan drives, so the timed results are not directly comparable. In general, though, the DAT drives were almost twice as fast as the Travan drives. Each drive ran the backup and restore tests three times, and we report the average scores for each product.—*Analysis written by Kristina DeNike and Ryan Snedegar*

Bold type denotes first place within each category.
Minutes:seconds

	Backup	Restore
TRAVAN		
Aiwa Travan TD-8001 NS8	9:13	13:31
HP SureStore T4e	13:51	18:08
Seagate TapeStor Travan NS8	10:36	21:53
Tecmar OfficeBackup Workstation	8:50	13:48
DAT		
HP SureStore DAT 24/e	5:13	5:27
Seagate TapeStor DAT 24	6:16	5:39
Sony WANBacker 9000	5:28	5:02
	◀ BETTER	◀ BETTER

through setting up proper SCSI termination and explains what a SCSI ID is.

Because it is a TR4 (and not an NS8) drive, the product doesn't provide any hardware compression or read-while-write verification. Unfortunately, hardware compression is usually much faster than a software solution. A case in point: The SureStore came in far behind the other drives during the backup test, and third—ahead of only Seagate's unit—in the restore.



TAKING THE STING out of backup maintenance, Seagate's Scorpion 24 DAT drive has a DOS-based diagnostic utility and tape-head cleaners.

After we installed the drive, we used the Tape Assure diagnostics to verify that the SureStore was working. This Windows-based utility checks the drive information, including the connection to the drive. It also performs a test backup and restore. When you're sure the drive is working, you can pick which backup software you need.

This package includes the Colorado Backup software to back up MS-DOS, Windows 3.x, and Windows 95—plus a copy of Stac

Electronics' Replica for Windows NT and NetWare. The Colorado software isn't as easy to use as Seagate Backup Exec, but it did let us perform manual and scheduled backups and restores. There is also a bug in the Replica for Windows NT that could make your PC freeze for a while during a restore. Fortunately, a flyer in the box alerts you to this problem and points

you to a fix available on Stac's Web site.

HP SureStore T4e. List price: \$559. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900, 800-387-3867, 650-857-1501; www.hp.com. Choose 906 at www.pcmag.com/infolink.

Seagate TapeStor Travan NS8

Though it doesn't back up NetWare or Windows NT Server, the Backup Exec software bundled with the Seagate TapeStor Travan NS8 is one of the drive's best selling points. But if performance is an issue for you, look elsewhere; the TapeStor was slowest on the restore, and nearly so on backup. Despite the unit's FastSense feature (offering three variable transfer rates), our tested model transferred mostly at its slowest rate.

In addition to software, the TapeStor package includes an NS8 Hornet drive, a mounting kit, a single TR4 cartridge, and fairly thorough documentation.

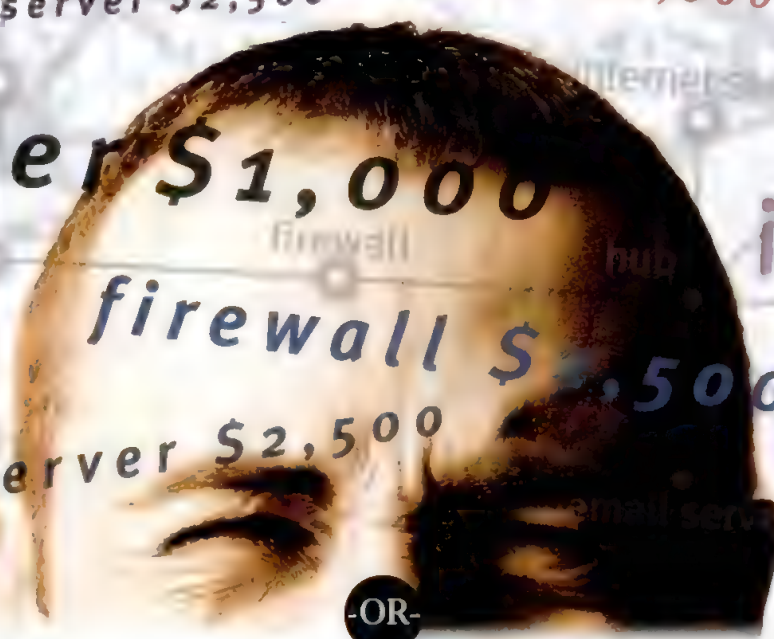
The TapeStor is priced at \$309 (list), but it's a better deal than Aiwa's \$299 TD-8001, the only other internal Travan drive in this roundup, which does not come with software. An external version sells for \$399. Like Seagate's DAT offering, TapeStor is the name of the kit. The package's price includes the single

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license of Seagate's Backup Exec workstation software, which will run on any PC based on MS-DOS, Windows 3.x, Windows 95, or Windows NT Workstation.

The Hornet is a SCSI-2-based device that should work with most of the popular OSs. Like all the other Travan devices in this roundup except Tecmar's (which provides two), the Hornet provides only a single LED on the front panel. Different colors and blinking intervals help you determine whether an error is due to the drive or the tape.

We liked the Hornet's documentation, which includes detailed graphics and easy-to-read text with questions to help you install the device. Unfortunately, we found an error: Instead of trying to explain that you must terminate the devices at both ends of a SCSI cable, the manual asks you whether this is the only device on the cable or if it's connected to other devices. Your answer will help you determine how to move the jumpers on the unit for proper termination and SCSI IDs. The manual then states that the drive is terminated by default, although this wasn't the case on the factory-sealed model we tested.

Like its DAT sibling (the Scorpion) the Hornet includes an MS-DOS-based diagnos-

tic disk you can use to troubleshoot a SCSI or drive problem. Only HP's drives also offer diagnostic software, which thankfully is

Windows-based. As long as you have the MS-DOS device drivers for your SCSI adapter—a potentially vexing problem—you can use the diagnostic utility to perform test backup-and-restore jobs and even save the results to a log-on file. Backup Exec lets you back up and restore all your files, including the registry information on your Windows 95- or Windows NT-based PC. You can also set up scheduled jobs.

Seagate TapeStor Travan NS8. List price: \$309. Seagate Technology Inc., Scotts Valley, CA; 800-732-4283, 408-438-6550; fax, 408-438-7852; www.seagate.com. Choose 907 at www.pcmag.com/infolink.

Tecmar OfficeBackup Workstation

The Tecmar Travan NS 8GB proved to be the top-performing Travan drive on our tests and a close second on the restore. As part of the tested package called the Tecmar OfficeBackup Workstation (\$710 list), this external drive is bundled with Cheyenne ARCserve



backup software for Windows 95 and Windows NT Workstation—plus SCSI cable, tape cartridge, and documentation. In fact, this

package has many of the same features as HP's SureStore, though without the more detailed documentation of both the SureStore and the TapeStor. It also is the priciest Travan solution in this roundup.

Tecmar offers several different OfficeBackup bundles. The others range from a \$585 internal drive, with the same software as the OfficeBackup Workstation, to \$895 for an external drive, complete with ARCserve for NetWare and Windows NT Server. If money is a big factor and you need to back up Windows NT and NetWare servers, the \$559 HP SureStore T4e package is probably the better value. The SureStore, however, is also a much slower solution.

Our only criticism of the Tecmar OfficeBackup Workstation's chassis is that the rubber feet kept falling off and were a little difficult to reattach to the drive. And though the unit was a breeze to install, its documentation is not as thorough as the SureStore's. There was not, for example, a good troubleshooting section, nor was there any diagnostic software.

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The bundled ARCserve software is on a par with the Backup Exec application included with the TapeStor, but it's easier to use than the SureStore's Colorado software. Like Colorado, ARCserve lets you perform manual backups or schedule them to run unattended. But where ARCserve stands out over Colorado is in its ability to generate reports on tape usage and the types of files copied to and from the tape.

Tecmar OfficeBackup Workstation. List price: \$710. Tecmar Technologies Inc., Longmont, CO; 303-682-3700; fax, 303-776-1698; www.tecmar.com. Choose 908 at pcmag.com/infolink.

DAT Drives

HP SureStore DAT 24/e

Its package didn't yet include backup software for NetWare or Windows NT at press time, but the HP SureStore DAT 24/e has everything else you'll need to start protecting your data within minutes of opening the box. This external DDS-3 SCSI device includes excellent diagnostic software, and its SNMP-capable notification application is helpful for

any workgroup setting that is part of a larger managed network. The SureStore proved to be the fastest solution on our backup test and came in second during the restore test. For those who like to choose their own backup software, the lack of server software shouldn't be an issue.

The SureStore's list price of \$1,673—the best deal of the vendor's external turnkey solutions, even without server software—includes the DAT drive, a 125-m. tape, a cleaning cartridge, a SCSI cable, a SCSI terminator, Colorado Backup software, the only three-year warranty in the roundup, and diagnostic and notification utilities. The drive is housed in a chassis about the size of a brick. This should make it fit easily on top of most file servers.

Unfortunately, Colorado Backup only works with DOS, Windows 3.x, and Windows 95. We feel most people will use a DDS-3 DAT drive on a Windows NT or NetWare server—not on a Windows-based client PC. (Interestingly, HP's sibling Travan drive, the HP SureStore T4e, includes Stac Replica for NetWare and Windows NT.) HP plans to offer bundled network backup soft-

Net Tools

TAPE BACKUP

ware with its DAT drives in the near future.

Like most external tape drives, the 24/e is a snap to install, and the manual ex-

plains what all the LEDs, ports, and switches do. We also liked the manual's troubleshooting section, which provides basic information on issues such as SCSI termination and IDs.

The bundled Tape Assure utility let us view information about our drive, test our connection to the device, and even perform a test backup and restore. Unlike the diagnostics software included with Seagate's drives (the only other products with such software), Tape Assure is Windows-based and doesn't make you load any ASPI drivers. The most original feature of the 24/e's bundled software is Tape Alert. This utility lets you send alerts and notifications to any SNMP-based console such as HP OpenView. Tape Alert can send a notification if the tape is bad, the drive has failed, or even if the device needs cleaning.

HP SureStore DAT 24/e. List price: \$1,673. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900, 800-387-3867, 650-857-1501; www.hp.com. Choose 906 at www.pcmag.com/infolink.

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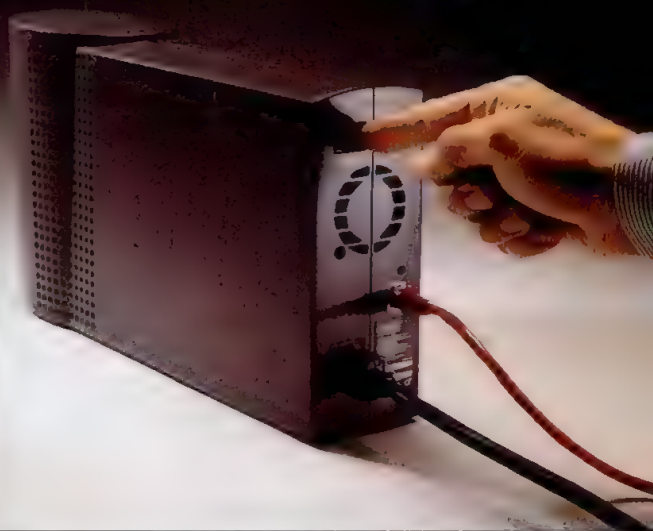
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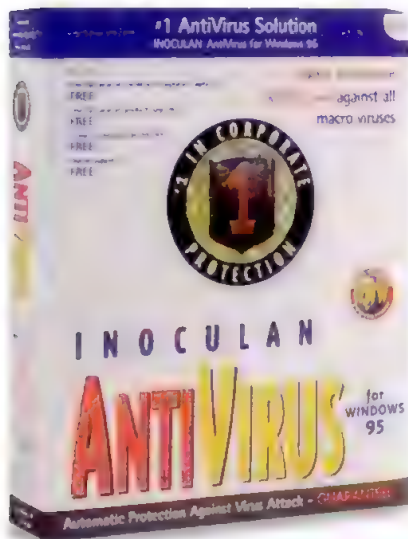


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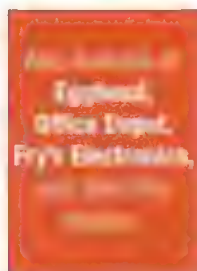
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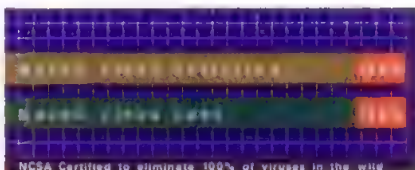
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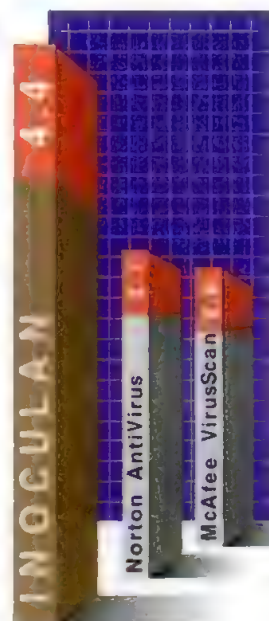
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Seagate TapeStor DAT 24

The flagship Seagate DAT drive is the Scorpion 24, and it forms the heart of the Seagate TapeStor DAT 24 package we looked at. One of the Scorpion's advantages over the Sony WAN-Backer 9000 is the bundled diagnostics utility, even though it's DOS-based. And although this unit proved to be among the slowest on our performance tests, the performance differences between DAT products were fairly small. Featurewise, the package is roughly comparable to its competitor from Hewlett-Packard.

If all you want is a bare-bones drive, the basic Scorpion drive is available in both internal and external models that retail for \$1,159 and \$1,309, respectively. The internal version includes only the drive, mounting kit, and diagnostic software.

The internal TapeStor DAT 24 kit we tested retails for \$1,569 and includes the Scorpion drive, Seagate Backup Exec Single-Server Edition for NetWare and Windows NT, diagnostic software, two 125-m. tapes, a mounting kit, and a cleaning cartridge. An external version of the package, excluding the mounting kit but including a SCSI-2 cable, is also available for \$1,859.

We were able to install the TapeStor on our Windows NT server within minutes of opening the box. The only thing we noticed was that Windows NT recognized the device as—and installed the driver for—an Archive Python DAT. Pythons haven't been on the market in years. Fortunately, although we could not use any other driver, both the Windows NT utility and Backup Exec worked without a hitch. The Scorpion documentation is a little better than what comes with the Sony WANBacker 9000. But like HP's documentation, it doesn't provide any detail on installing the device with any particular operating system or backup program.

Like the other DATs, the Scorpion incorporates an internal head cleaner to provide preventive maintenance. The internal cleaner will wipe the tape heads if there is an error and at periodic intervals. Also, as with the other DAT drives in this roundup, the Scorpion comes with a replacement policy. But unlike the HP and Sony policies, which offer 24-hour replacements for failed drives, Seagate's policy requires two days. And as with the HP unit, you must also provide Seagate with a credit card number before the vendor will permit cross-shipping for a new unit.

Net Tools

TAPE BACKUP

One thing we liked about the TapeStor was the bundled diagnostics disk, from which the server will boot. What we didn't like,

though, was the need to use the DOS ASPI drivers to make the utility work. This requirement means that you have to find the DOS-based device driver that came with your SCSI controller and manually edit the

disk's Config.sys file. Unfortunately, some SCSI controllers no longer ship with DOS device drivers. The HP SureStore DAT 24/e offers a similar Windows-based utility that is much easier to use.

Seagate TapeStor DAT 24. List price: \$1,569. Seagate Technology Inc., Scotts Valley, CA; 800-732-4283, 408-438-6550; fax, 408-438-7852; www.seagate.com. Choose 907 at www.pcmag.com/infolink.



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Sony WANBacker 9000

If nothing else, the Sony WANBacker 9000 wins the award for the most interesting name of all of the products in this roundup. But there's plenty more to interest prospective buyers who can handle the \$2,639 price tag. This DDS-3 external tape drive is part of a package that includes Computer Associates' ARCserve. The WANBacker package provided the best per-

formance on our restore test and came in second on the backup test. The biggest thing missing (besides a cable) is documentation on how to use the drive with software other than ARCserve, a failure shared by the other DAT drives as well.

True, the WANBacker's price is higher than those of other DAT solutions in this roundup. But consider all the options you get:

In addition to the external DDS drive, there's a 125-m. tape, a 4-mm cleaning cartridge, a SCSI terminator, and CA's ARCserve (reviewed in "Back Up Against Disaster," *PC Magazine*, March 24, 1998).

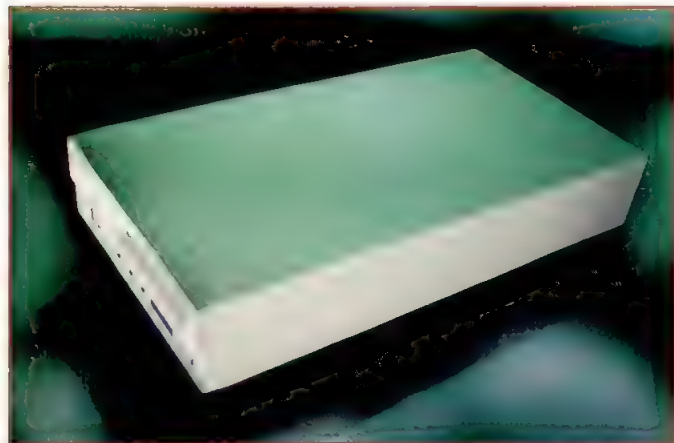
The external WANBacker is about the same size as an external CD-ROM drive. The chassis has separate LEDs for power,

busy, status, and tape. The status LED blinks at various intervals to alert you to different problems, such as a dirty head or a drive

malfunction. We were able to change the SCSI ID by pushing buttons on the back of the unit, and the bottom features jumpers you can change to let the unit work with various Unix workstations. (The default is an Intel-standard setup.)

In general, the product was a snap to install, especially if you use the bundled ARCserve software, which offers the best multiple-platform support and, for the Windows NT version, easy restoration of crashed systems across the wire. Though the manual is fairly short, it does step you through all the drive's features and specifications. And should you require a replacement unit, Sony is the only vendor in this roundup that will cross-ship a new drive to you without first demanding a credit card number.

Sony WANBacker 9000. List price: \$2,639. Sony Electronics Inc., San Jose, CA; 800-352-7669, 408-432-1600; fax, 408-943-0740; www.sony.com/storagebysony. Choose 911 at www.pcmag.com/infolink. **PC**



SWITCH-HITTER: By pushing a button on the Sony WANBacker 9000, you switch its SCSI ID between Intel and various Unix workstation settings.

BACKUP ALTERNATIVES

AIT, DLT, and Mammoth

By Steve Rigney

The Travan and DAT drives in our roundup should handle the needs of most small and medium-size networks. But if you need more capacity and lots more speed, you need a higher-end tape drive. The three most widely available drive types are the Sony Advanced Intelligent Tape (AIT), Quantum Digital Linear Tape (DLT), and Exabyte Mammoth 8-mm drives. Each of these holds a minimum of 20GB of uncompressed data and provides higher sustained transfer rates than either Travan or DAT.

AIT is a fairly new, Sony-developed drive technology that uses the same-named media format. The current specification model can store 25GB on a single 8-mm cartridge. AIT drives, also sold by Seagate, use a unique 2.1:1 ALDC compression scheme that lets a cartridge hold up to 65GB. This makes the device second only to the DLT-7000 in capacity.

ALDC also helps the AIT drives' sustained transfer rates, permitting transfer

rates of up to 7.8 MBps (much faster than the normal uncompressed transfer rate of 3 MBps). The AIT drive uses the same helical scan method as the Exabyte to write data to tape. Unlike the DLT devices' linear serpentine method, a helical scan writes at an angle to the tape media for greater capacity per area of tape. AIT drives retail for \$3,000 to \$4,000—about the same price as a DLT-4000 drive.

Currently, DLT drives are manufactured only by Quantum, but several vendors, including HP and Procomm, sell them. The major difference between the two DLT specifications, DLT-4000 and DLT-7000, is in the amount of data they can hold. DLT-4000 media hold 20GB of uncompressed data and up to 40GB of data using hardware-based DLZ compression. DLT-7000 media use the same DLZ compression but can hold 35GB of uncompressed, and up to 70GB of compressed, data.

DLT-7000 devices hold more data than DLT-4000s because of the way they write to tape. Though both drives use the

linear serpentine method, the DLT-7000 drive uses a modified linear serpentine method called Symmetrical Phase Recording (SPR). In a nutshell, SPR rotates the head assembly into three different positions, which lets it write data in a more condensed herringbone pattern. DLT drives also offer some of the highest sustained data-transfer rates: You can achieve uncompressed/compressed rates of 1.5/3 MBps with the DLT-4000 and uncompressed/compressed rates of 5/10 MBps with the DLT-7000. Expect to pay \$3,000 to \$4,000 for a DLT-4000 drive, making AIT the better choice if you're backing up 30GB or more. A DLT-7000, the type with the largest capacity of the three drive families, will cost you about \$8,000.

Mammoth is the latest incarnation of the 8mm helical scan drive that Exabyte introduced in 1985. This drive can store up to 40GB of compressed data on one cartridge. Like DLT, the Mammoth provides 2:1 compression, but it uses an IDRC, not a DLZ, compression algorithm. The Mammoth also provides a sustained data-transfer rate of 3 MBps when uncompressed and 6 MBps when compressed. One of these drives costs about \$4,000.

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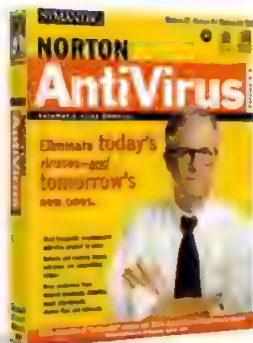
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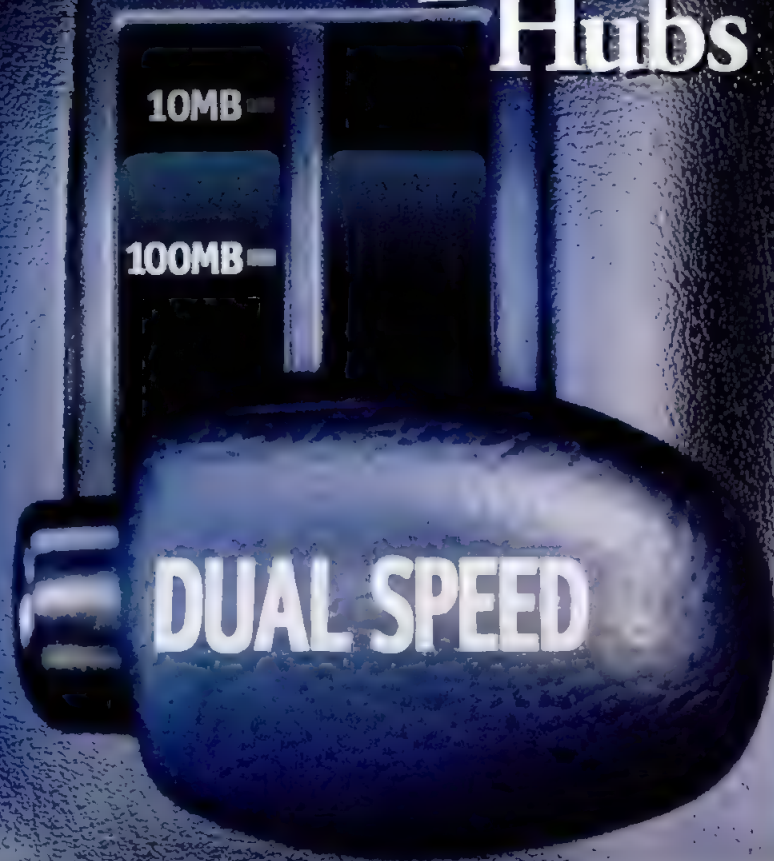


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FROM THE BENCH

ENTERPRISE MANAGEMENT

Marshaling Windows NT Rights

By Rigney

to have dealt with administrative rights Windows NT know nothing proposition you assign to throughout the domain can be a nuisance a major

a visit. On the other hand, one downside of the product is that when you install it you have to enter all user names by hand, since it does not come with a user-import feature.

EA includes three software components: the server service, a service agent, and a console.

The server service runs on either the primary or the backup domain controller; you must install the service agent on all of your network's other domain controllers. The console, which runs on any Windows-based client PC, lets you configure your EA settings. The service agent acts as a proxy to the Windows NT security database. When users connect to the domain, they go through the proxy connection that controls what they can access.

Each of the components requires only a few minutes to install. You'll need a lot longer, though, to configure your users, groups, and resources.

The Houston-based Mission Critical has adopted a Wild West theme to describe EA's Windows NT security. Administrators are **Marshals** and make **Deputies** of specific users, who have control over other users, groups, and resources, or **Territories**. Administrators can give Deputies only limited rights over certain servers and users, which is extremely difficult to do with basic Windows NT.

In our test Territory, we set up a Deputy with control over the single server. After we logged on to the Windows NT domain as the Deputy and launched the EA client to configure the server and security, we could see servers and resources only in our Territory, not any of the test-bed's other servers. We were also able to give the Deputy the right to reset password-access control but not the right to access and change other security settings.

In addition to controlling users, groups, and resources, EA is a powerful tool for tracking users and keeping an audit log.

After we enabled logging, we were able to keep track of our Marshals and Deputies and watch what they were doing. For example, we could determine whether a password changed, when it changed, and who changed it. You can print your logs or export them to other programs, such as Microsoft Excel. **Enterprise Administrator 4.5.** List price: \$900 per managed domain, \$16 per managed account. Mission Critical Software Inc., Houston; 888-323-6768, 713-548-1700; www.missioncritical.com. Choose 900 at www.pcmag.com/infolink.

ETHERNET HUBS

A Hub Above Hubs

By Steve Rigney

Except for the bells and whistles, it is hard to tell one hub from another. Hewlett-Packard Co. obviously knows this: The company has put a lot of outstanding features into the new HP 10Base-T Hub 12M (\$549 list). This manageable hub provides 12 10-Mbps ports and excellent Windows-based management software. But what makes it truly stand out is its Web-based management, which will be available with all of HP's new lines of hubs and switches (they will be on sale by the time you read this). The software not

only alerts you to problems but also advises you on how to fix them. In fact, detailed status LEDs are all the unit lacks.

The Web-based management is by far the 12M's most attractive selling point. The utility relies on the hub's built-in Web server and Java to provide detailed graphics and performance gauges that display the hub's status in real time.

Our favorite Web management feature is HP's Find, Fix, and Inform. It looks for network problems related to the hub, fixes them if possible, and informs you about the errors. On our test-bed we created a net-



SEEING IS BELIEVING: The 12M's Web-based management utility lets you view your hub's status in real time from a Java-enabled browser.

Net Tools

FROM THE BENCH

work loop, where packets traveled through the same segment twice. The 12M not only detected and informed us of the problem but also eliminated the loop.

If you don't want to use a browser or you need to manage multiple HP hubs and switches at once, you'll want to install Assistant, a bundled Windows-based utility. It is a snap to set up and automatically detects all managed HP devices on an IPX- or IP-based network. Assistant also draws a graphical representation of all devices on the LAN. When

you select an HP device using Assistant, the software automatically launches your browser so you can see more detailed information; it also lets you change the unit's configuration.

HP 10Base-T Hub 12M. List price: \$549. Hewlett-Packard Co., Palo Alto, CA; 650-857-1501; www.hp.com. Choose 901 at www.pcmag.com/infolink.

OS INTEGRATION

Peaceful Coexistence

By Daniel B. Levine

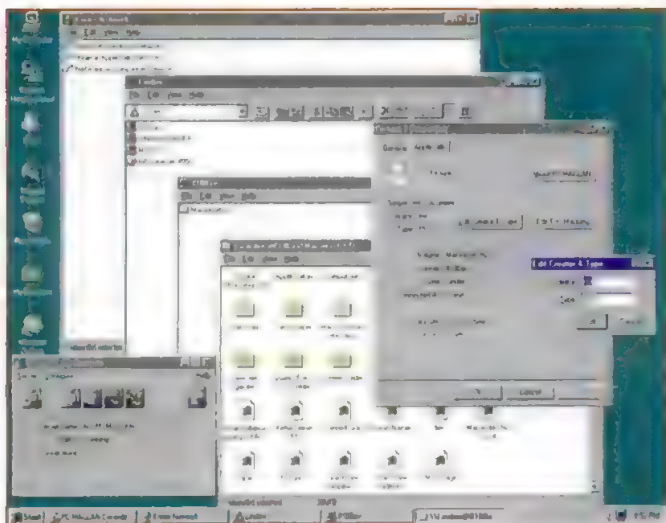
Apple Computer has worked hard to let Mac OS users exchange files with their far more numerous Windows brethren. The road to compatibility, however, has been something of a one-way street: Windows NT Server lets users connect to AppleTalk devices, but Windows NT Workstation does not.

Fortunately, Miramar Systems has taken up the slack with products such as PC MacLAN, which is in Version 6.1 for Windows 95. Now the company has released a version for Windows NT 4.0: PC MacLAN 6.1 for Windows NT (\$249 list). It lets Mac and Win-

dows NT users swap files, use peer-to-peer networking, and share AppleTalk and Windows printers.

Of course, Mac OS clients can already connect to Windows NT using Microsoft's own Services for Macintosh server, which comes with Windows NT Server. But this service works only with NTFS-formatted volumes. PC MacLAN works with both NTFS and the older FAT16, which is compatible with DOS and Windows 95 and is used in dual-boot systems.

After a quick and painless installation on Windows NT Workstation, we saw a new network (Miramar AppleTalk Network)



WRITE YOUR OWN: If PC MacLAN does not support a file type that you use, you can configure it to support that file type.

pop up under Windows NT's Network Neighborhood. Depending on your LAN's configuration, this network may include any AppleTalk file servers, peer-to-peer servers, and printers, along with servers running Windows NT's Services for Macintosh and NetWare servers with AppleTalk installed.

For the most part, these new AppleTalk devices work like any

machines using AppleTalk peer-to-peer networking. Before we could do this, we needed to run File Server from the PC MacLAN program group. This application let us configure users and groups and decide which drives and folders could be shared. Once started, our Windows NT workstation (a Quantix PC) was immediately visible to our Macintosh Power

CROSS TALK



Before, with a hybrid Macintosh/Windows NT network, you needed to load Windows NT Server on your clients. Now any Windows NT user can print to AppleTalk printers.

Printing is still the most important reason to network, Leon, and it's also one of the most important reasons to use PC MacLAN.

I agree with you, Frank. For situations (such as product combining AppleTalk su with MMX-enabled pre tools lets you leverage you intosh infrastruc- ture investments, which may be quite substantial. It also gives you a choice of plat- forms in the future.

other network resource. Windows NT users can map Macintosh drives over the network using the same nomenclature as for Windows NT or NetWare volumes. A key difference, however, is the way Mac OS and Windows NT determine the documents that belong to applications. For example, Windows NT recognizes a Microsoft Word document by its .doc extension; Mac OS, on the other hand, identifies each file with two hidden IDs that determine the file type and creator application. PC MacLAN automatically translates between the two systems but only for a number of frequently used applications, like Adobe Photoshop and Microsoft Word.

If your system uses a file type PC MacLAN doesn't recognize, you have to enter the file information using an option in the file's AppleTalk properties page. You access the page by right-clicking on the file.

PC MacLAN also lets Mac OS clients connect to Windows NT

8100AV through the File Transfer Chooser. File transfer between Macintosh side takes System 8's built-in Dialers and the PC Ethernet control panel.

To test PC MacLAN capabilities, we installed a wide-carriage Loo Stylus Color 1520 T network. The immediately visible NT, and clicking brought up the setup wizard. (LAN, installing printing to an A works exactly a printer under addition, a P that's connected windows NT system with Macintosh Printer Server application.

PC MacLAN 6.1 List price: \$249. Miramar Systems Inc., Santa Barbara, CA; 805-963-2432; fax, 805-963-2433; www.miramarsys.com; www.pcmag.com

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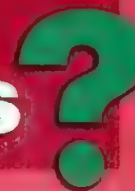
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Net Tools

INTERNET TOOLS

INTERNET2

Internet: The Next Generation



By Stephanie Izarek

Everyone deserves a second chance—even the Internet. No, the Internet has not completely failed us. But if we can ever expect it to catch up with—let alone exceed—our lofty and growing expectations, a major revamping is vital. Fortunately, one is on the horizon: the Internet2 Project.

The point of Internet2, or I2, is not to replace the current Internet but to provide a platform of technological experimentation and innovation. The bottom line for current users? The clearing of many bandwidth bottlenecks, for one thing. Other goals include more sophisticated audio- and video-streaming technologies and true data-sharing capabilities.

The I2 Project's stated mission is the aggressive pursuit of advanced networking technologies that break through the Internet's current limitations, and the preparation of a network struc-

ture worthy of the future—one requiring high-speed data transmissions, real-time collaboration and data sharing, quality-of-service (QoS) guarantees, and multimedia streaming. Solutions will eventually make it to the mainstream Internet—by 2002, if all goes according to the plan set forth in the Clinton administration's Next Generation Internet Initiative.

The Project will also police the developmental front lines to ensure that any forthcoming hardware and software developments are based on open standards and that new solutions are readily available to commercial network users and ISPs.

Currently, I2 is a closed but not separate IP-based network, dedicated to 117 universities, the government, and about 25 corporations. It's also plenty fast; MCI claims that the 622-Mbps rate is speedy enough to send 322 copies of a 300-page book every 7 seconds.

One of I2's immediate benefits is that off-loading the academic research and government traffic will surely speed network use for all mainstream as well as I2 Internet users. But what truly differentiates I2's creation from that of the original Internet is the involvement of private business in the development of I2's infrastructure. This is key: Solutions can reach mainstream users more efficiently through the high-speed and high-performance products these vendors will build.

In the project's first phase, over an anticipated three to five years, end-to-end broadband network services will be established for the participants. Simultaneously, university faculty, researchers, technical personnel, and industry experts will start to design the advanced applications. By early 1999, numerous beta versions of applications are expected to be in use on I2—with solutions for the mainstream Internet following closely behind.

CENTRAL TO SUCCESS

The maintenance of a common bearer service for all network apps is central to I2's success. Today, that bearer is IP, Version 4.12; I2 will rely on IP, Version 6 (IPv6), once that's ready to go (for background, see Internet Tools, "IPv6: Will Good Sense Pre-

vail?", February 24, 1998). Preserving IP's appeal—letting all the nodes communicate in one compatible transport format—is significant.

You can view MCI's Very High-Speed Backbone Network Service (vBNS) and the National Science Foundation as the 622-Mbps heart of I2. Although I2 will eventually employ other high-speed networks, vBNS activity should spawn a new breed of hardware, protocols, and transmission technologies. It should also encourage the deployment of advanced routing mechanisms, protocol enhancements, and new performance-testing methods.

Currently, I2 can link six NSF supercomputer centers (SCCs) that act as gigabit test-beds. With the help of Cisco, IBM, and MCI, the I2 group also hopes to address the needs of system architects developing the advanced nodes, or hubs, called GigaPOPs (*giga— for billion bits per second— and POP, for point of presence*). Essentially, GigaPOPs are the network aggregation points that can quickly connect campuses, labs, and eventually urban-area and state/regional networks.

WORK IN PROGRESS

Quality-of-service (QoS) guarantees, merely a dream on today's

Popping Up All Over

GigaPOPs, points of presence that can handle gigabit speeds, are network aggregation points—and the cornerstone of the new Internet. Initially, they'll connect labs and campuses. Later on, they'll connect urban, state, and regional networks.



GigaPOP sites

Net Tools

INTERNET TOOLS

Internet, are probably the most critical work in progress. Not only does QoS play a major role in IPv6, but advanced networking applications being developed also require it.

All data on the Internet, after all, currently gets equal priority. At its most basic, QoS will set priority levels for transmitted information. This should speed all transfers, making real-time interactivity possible.

To address such issues, the members of I2's QoS Working Group have met twice this spring to explore a profile-based, differentiated-services approach to Internet2 QoS. Major topics debated included the management of enterprise/campus QoS, QoS enhancements in the vBNS, and authentication and authorization infrastructure.

One expected by-product of I2 will be the birth of advanced networking applications—the underlying support technology that will emerge over time.

In the works, meanwhile, is a move away from the traditional client/server architecture—a departure that will differentiate applications enabled by I2. But lest you think present standards have no place, I2 researchers are also focusing on object-oriented development tools and distributed object architectures, such as ActiveX, DSOM, Java, and OpenDoc, as the foundation for creating networked content for learning. Using these technologies, I2 hopes to resolve issues like authentication, authorization, and security to extend application functionality over the network.

Current efforts focus on exploiting the broadband networks' media integration, interactivity, and data-sharing potential as fully as possible. Also underway is development of applications that foster collaborative research among I2 members conducting

experiments, along with an enhanced delivery system for services such as health care. Alongside these efforts comes the necessary creation of middleware and development tools that support these advanced applications.

I2's Instructional Management System (IMS)—which consists of a set of protocols, special middleware (created for use in a high-bandwidth, low-latency environment), and client tools—provides a unique platform for the delivery of learningware in a so-called distributed instruction environment. Under the new IMS infrastructure, students can experience real-time data collection and analysis as though they were present in a lab, working with partners from various campuses.

Under the Internet2 infrastructure, the ability to move digital libraries may also become a reality. Very high bandwidth and bandwidth reservation will let continuous digital audio and video migrate from research-only use (the Carnegie Mellon University Digital Library Project, for example) to much broader applications and include images,

audio, and video in ways not currently possible. This should ease the organizing, indexing, and provision of access to the most up-to-date materials.

Though most information today remains textual, a great amount of research on information visualization is ongoing, notably in facilities such as Xerox PARC. This research promises to help users in organizing, navigating, and comprehending complex information visually. The catch is that it requires sophisticated high-resolution graphics and animation to provide the visual representations.

Granted, realizing this vision is a tall order. Developers need to incorporate 2-D and 3-D graphing templates, mathematical modeling templates, symbolic computation, a mathematical scripting language, molecular modeling templates, intelligent periodic tables and atomic bonding tools, tools for synchronizing temporal data like music, and bilingual lexical databases.

Similarly, more sophisticated multicasting capabilities are on the table for I2's Applications Working Group (discussed in "Bandwidth on a Budget," PC

Magazine, January 6, 1998). This work requires high reliability over the network and QoS with low-speed connections. PointCast information-delivery services over the Internet only hint at what may be possible for I2, where the hope is that streaming information of all types—database updates, publication announcements, telemetry, and sensor readings—will become a reality.

BEYOND THE CAVE

The next step beyond multicast technology is another buzzword: tele-immersion. A tele-immersion system lets individuals at different locations share a single virtual environment. Beyond games, this has incredible implications for education, science, and manufacturing.

Stemming from CAVE (*Computer Automatic Virtual Environment*) technology, tele-immersion combines advanced, high-speed telecommunications systems to support collaborative applications. It also adds extensions to CAVE technology for recognizing the presence and movement of individuals within a particular space. Tele-immersion will track the movements and then permit them to be projected in multiple, distributed environments, where individuals will be able to interact with computer-generated yet realistic models.

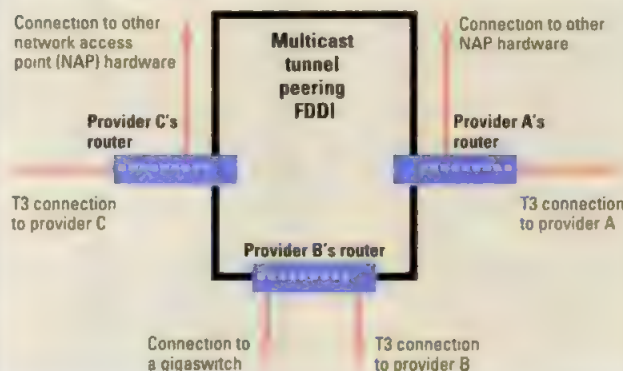
Tele-immersion is probably the most ambitious application type of all. Given this type's notably high bandwidth, low latency, and time-dependent synchronous nature, it requires technological leaps in traditional Internet infrastructure.

At the very least, the Internet2 experiment is fascinating. At best, it will revolutionize the way we think, learn, create, conduct business, and socialize.

Until the project is farther along, no one can predict with certainty how it will affect the future of the Internet. We can safely say, however, that it shows huge potential for one great goal: picking up where the Internet has left off. **PC**

A Matter of Conservation

Since many of the advanced Internet2 applications focus on real-time communication and data sharing, a more sophisticated type of multicasting technology is necessary. Here we see a possible tunneling scenario that would enable a faster, higher-quality broadcast.



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DEC1168 Ascend Pipeline 130 (T1 CSU, ISDN BRI)	\$1279.00
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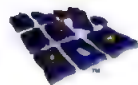
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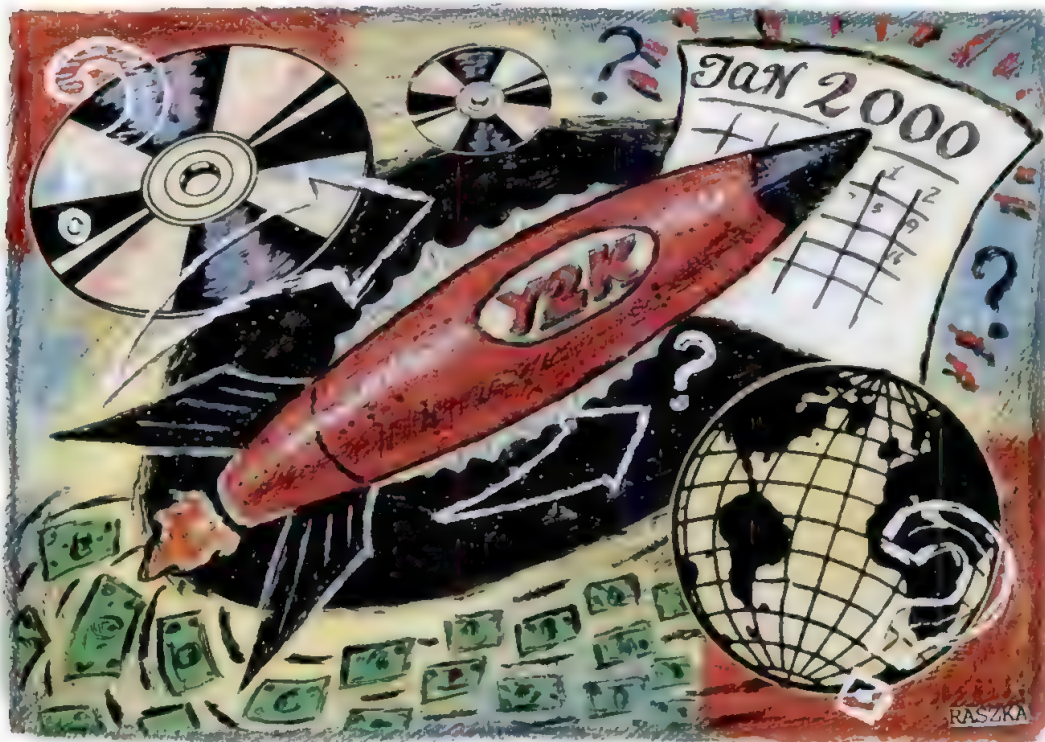
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PC Tech



Y2K for VB Developers

We take a look at some of the problem areas you may encounter in your systems and applications.

By Keith Pleas

By now you've likely formed your own opinion as to just how much the year 2000 (also called Y2K or *millennium*) problem is going to affect your applications. I'm not going to try to convince you that the problem (which IBM, with characteristic understatement, calls the year 2000 "challenge") is enormous or that it's trivial. As a developer, you've certainly made up your own mind by now. But you do need to know how your users are likely to be affected, and even if you're convinced the problem won't affect you directly, you still have to deal intelligently with the Chicken Littles within the IS community. With that in mind, I'm going to highlight the potential problem areas—which could range from minor display irregularities to abnormal program execution—and

discuss ways you can minimize the effects of the transition into the 21st century.

TECHNICAL ASPECTS

The root of the Y2K problem lies in the practice of assigning only two digits to a year in a date (for example, 98 for 1998), under the assumption that all years fall in the same century. Such dates, starting in the year 2000, would be handled as if they were actually in the early 1900s. In legacy systems—generally mainframe COBOL applications—the use of two-digit years was a common method of conserving precious storage resources. Although most PC-based applications don't store dates in this way, they

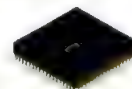
sometimes use two-digit representations of years in displaying information, handling keystrokes, and generating reports. And many applications

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You'll find all of the articles, examples, and code files in this section at PC Tech Online.

INSIDE

TUTOR: Computers can do a lot of amazing things these days, but how much do you know about the device that makes it all possible—the microprocessor? We look at what microprocessors are made of and how they perform their magic starting from just 0s and 1s. *Page 254.*



POWER PROGRAMMING:

DVD will become increasingly important in the PC market, and with its new interfaces, DirectShow is currently the only realistic programming environment for DVD. *Page 261.*



UTILITIES:

MultiRen

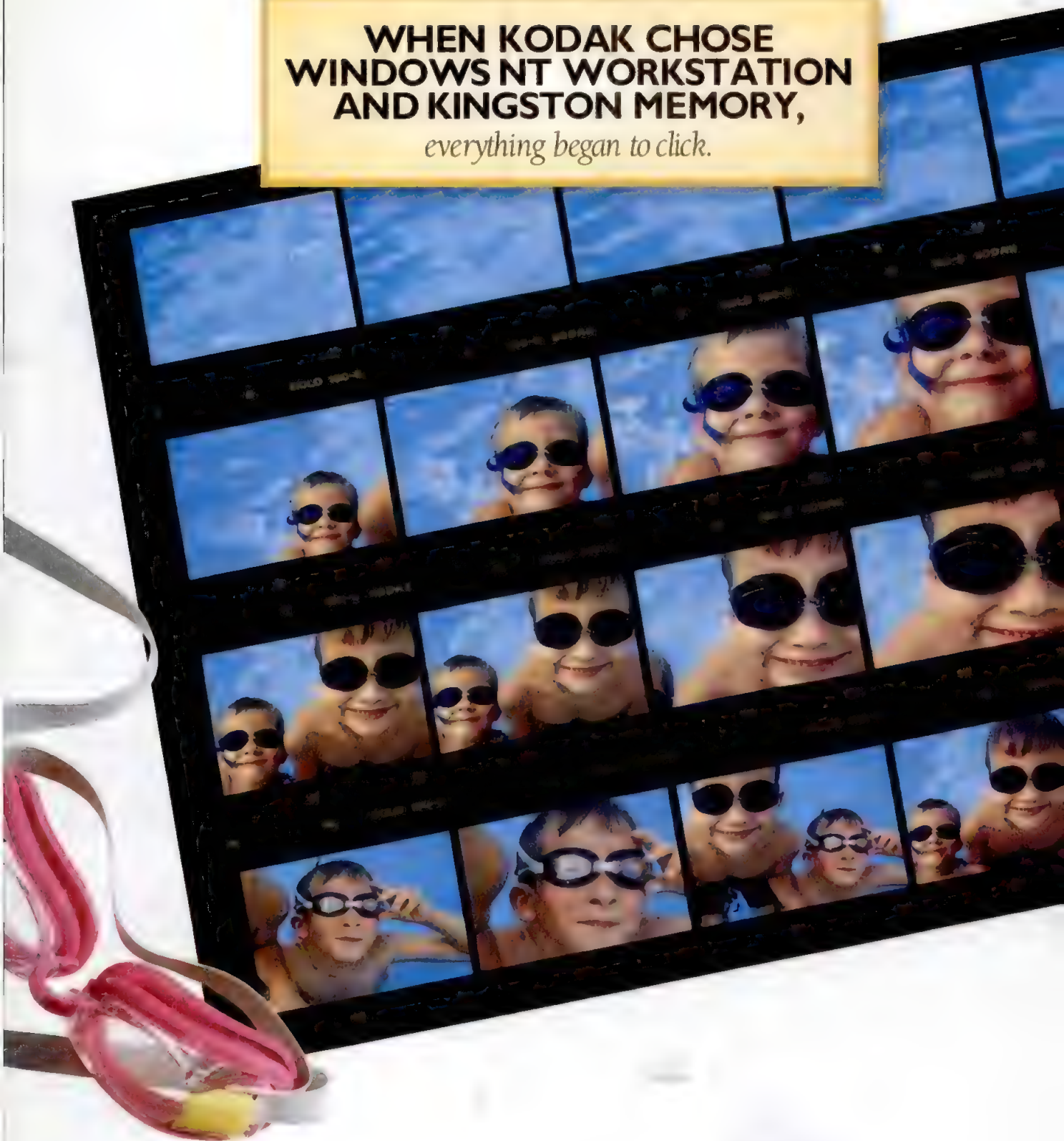
enhances Windows Explorer with the ability to rename many files at once using templates—something that could be done previously only by shelling out to DOS. *Page 269.*

PC SOLUTIONS:

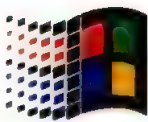
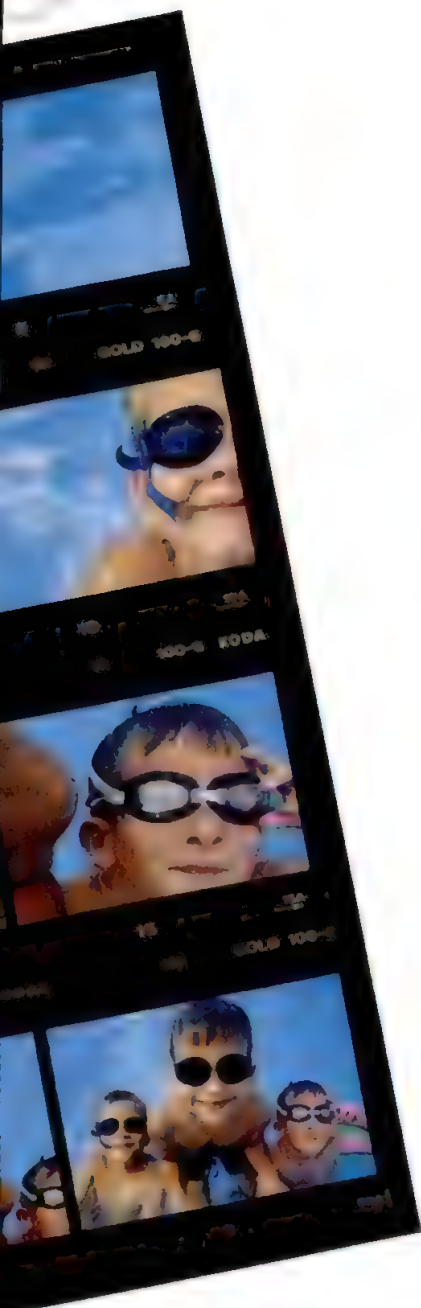
Attaching more than four IDE devices to a desktop system; changing the icons for Windows 95 folders; stepping through WordPerfect macros; custom number formats in Excel; getting Access reports to act on user input; and more. *Page 285.*



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Resources

With so many prophesying Y2K disaster, useful, unbiased information can be difficult to find. A good place to start looking is the Web, at the sites of The Mitre Corp. (www.mitre.org/research/cots/COMPLIANCE_CAT.html), the

National Institute of Standards and Technology (www.nist.gov/y2k/index.htm), and the National Software Testing Laboratories (www.nstl.com). The sites offer a variety of compliance-related information and links that include (on the Mitre and NSTL sites) detailed, up-to-date lists of Y2K-compliant products.

The University of Florida has a useful list of vendors' Y2K compliance statements relating to hardware and software (www.is.ufl.edu/bawb052h.htm). For a more comprehensive but less objective view, look at Y2K consulting guru Peter de Jager's very useful Year 2000 Information Center (www.year2000.com). One other place to find some useful discussion of Y2K issues is in the Usenet newsgroup *comp.software.year-2000*.

If you're concerned about Y2K hardware compatibility, you can get free testing tools such as Tom Becker's Test2000 (www.righttime.com) and NSTL's YMark2000 (www.nstl.com/html/ymark_2000.html). You can find links relating to OS patching and third-party solutions at www.mitre.org/research/cots/PATCH.html.



must interface with external systems that expect or generate dates with two-digit years. In PCs—even those running 32-bit operating systems like Windows 95 or NT—the Y2K problem can manifest itself in several areas, including hardware, operating systems, and—most important—customized software.

The year 2000 is also a leap year—1900 was not—and that could lead to additional problems. Applications running in the “wrong” century would fail to roll from February 28 to February 29 and then to March 1.

HARDWARE COMPLIANCE

Your PC must pass two separate tests to be hardware-compliant with the new century. First, it must be able to roll over from 1999 to 2000 while running. Almost all PCs can do that. Second, a PC must retain the correct system date after rebooting. Many AT-class machines with older BIOSes may fail the second test. Windows NT (Version 3.51 with Service Pack 5, Version 4.0, and later releases) and Windows 98 (scheduled for release later this year) address this problem by detecting system dates earlier than 1920 at boot-up and automatically changing the system date to the 21st century. Of course, failing either test is not necessarily fatal to a given application, and in any case, older machines can usually be brought up to speed without having to be entirely replaced. (See the September 23, 1997, Tutor column, “Welcome to the Millennium,” for additional information.)

OPERATING-SYSTEM COMPLIANCE

All Microsoft operating systems beginning with DOS 5.0 are internally Y2K-compliant (see the table on the right), but there are some situations in which dates may be displayed incorrectly—for instance, using the Windows 3.x File Manager in Windows 95. For such cases, Microsoft has generally provided fixes or workarounds. Windows NT consistently implements universal coordinated time (UTC), a global time standard that supersedes Greenwich mean time (GMT). So if a New York user on a worldwide network saves a file to an NTFS partition at 8:00 A.M., another user in England would see the same file as having been saved at 1:00 P.M.

APPLICATIONS SOFTWARE COMPLIANCE

When it comes to software, the situation rapidly becomes much more complicated. The most common standard for representing

dates is *mm/dd/yy*, which gives 07/04/98 for July 4, 1998. This standard, including the slashes, has been approved by the U.S. government's National Institute of Standards and Technology (NIST). In Canada and the many European countries, however, the day commonly precedes the month. Some countries use periods where we use slashes, and still others start dates with the year, as in 98-07-04. (This last method has the advantage that dates in character strings can be easily sorted in correct sequence—at least up until 2000.) To handle dates beyond 2000, NIST has proposed the format *yyyymmdd*, and the International Organization for Standardization (www.iso.ch) has specified *yyyy-mm-dd*.

A data-based approach to making applications Y2K-compliant involves widening and reformatting virtually everything that deals with dates, including screens and printed reports. Fortunately, in Windows 95 and NT, the display of dates is user-configurable by means of the Regional Settings Control Panel applet. Well-designed software—including much commercially available packaged software—respects a user's preferences, and in such cases Y2K compliance becomes straightforward. (As a rule, programs should use system-provided date formats and routines unless they are known to produce incorrect results.)

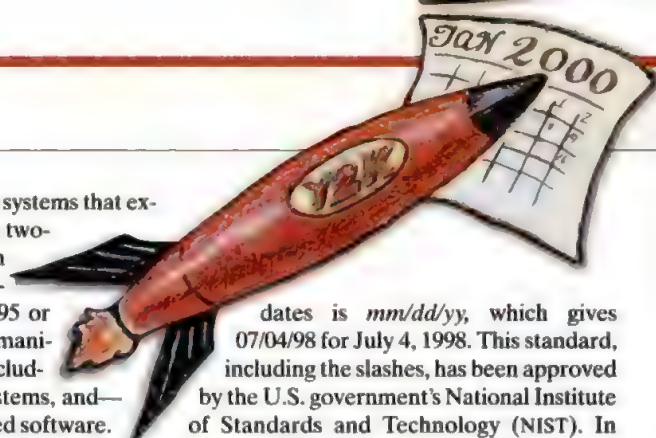
The other major approach to handling dates is process-based and involves a technique called *windowing*, which in this context

OPERATING-SYSTEM DATE LIMITS

Component	Operating system	Date limit
FAT16 file system	DOS, Windows 3.x, Windows for Workgroups, Windows 95, Windows NT	2108
FAT32 file system	Windows 95	2108
NTFS	Windows NT	29601
WIN32 runtime library	Windows 95, Windows NT	2099

means creating a 100-year period (or *window*) and assuming that dates that don't explicitly specify a century must fall within that span. Many legacy programs use the technique implicitly in assuming that all years are in the 20th century, which corresponds to a fixed window from 1900 through 1999.

Microsoft's software has evolved over the last several years from assuming the current century to relying on date services provided by the OLE Automation Library (see the table “Date Assumptions in Microsoft Software”). Microsoft formerly used a window



DATE ASSUMPTIONS IN MICROSOFT SOFTWARE

Product	20th century	21st century
OLE Automation Library 2.10 and earlier (Windows NT 3.51 prior to Service Pack 4)	1/1/00–12/31/99	Use 4-digit year
OLE Automation Library 2.20 (Windows NT 3.51 with Service Pack 4 and later, Windows NT 4, Windows 95 OSR 2)	1/1/30–12/31/99	1/1/00–12/31/29 (or use 4-digit year)
Microsoft Access 7 and earlier	1/1/00–12/31/99	Use 4-digit year
Microsoft Access 97	Uses OLE Automation Library	Uses OLE Automation Library
Microsoft Excel 4, 5, and 7	1/1/20–12/31/99	1/1/00–12/31/19 (or use 4-digit year)
Microsoft Excel 97	1/1/30–12/31/99	1/1/00–12/31/29 (or use 4-digit year)
Visual Basic 3.0 and earlier (Vbrun300.DLL)	Uses current century	Uses current century
Visual Basic 4.0 (16-bit)	Uses current century	Uses current century
Visual Basic 4.0 (32-bit) and later except DateSerial function)	Uses OLE Automation Library	Uses OLE Automation Library

from 1900 through 1999; recent releases of 32-bit Windows have adopted a window from 1930 through 2029. Here's how you can find out which window your system employs:

- The OLE Automation Libraries are contained in \Windows\System\Oleaut32.dll.

Using Windows Explorer, locate the file.

- Right-click on the filename to bring up the *Properties* dialog and select the *Version* tab, which shows the file version (Figure 1).

- If the file version is equal to or greater than 2.20.4049, then your system uses a window that runs from the beginning of 1930 to the end of 2029. If the file version is less than 2.20.4049 (Windows 95 or Windows NT 3.51 prior to Service Pack 5), then the date window corresponds to the 20th century.

Confusingly, Microsoft has also shipped Oleaut32.dll—actually a part of the operating system—with Internet Explorer 3.0 and above, Office 97, Visual Basic 5.0, and other products.

In applications that use character strings to represent dates, the data-based approach of fully specifying the year makes operations like sorts, comparisons, and calculations much easier. But in addition to converting your programs to handle four-digit years, you also have to convert all your existing data to the new format. And where your applications interface with external systems over which they do not have control, you may still have to use windowing techniques

for importing and exporting data. Moreover, some systems use codes (typically 00 or 99) embedded in the year to represent special statuses, such as on-hold orders or discontinued parts.

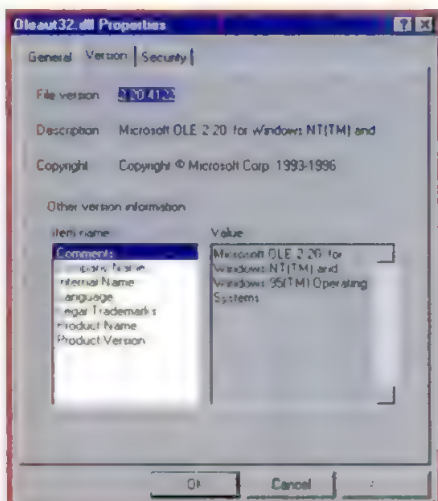


FIGURE 1: View Oleaut32.dll's Properties dialog box to find out the version of the file.

100, to December 31, 9999. Expressions—including date literals, numbers, and strings—can be converted to dates using the CDate function or, in VB 3.0, CVDate; and dates can be converted to numbers. For instance, the following code displays a message box (Figure 2) with the value of a Date variable and the value of the same variable converted to a Double:

```
Dim dteTest As Date
dteTest = Now
MsgBox dteTest &
Chr$(10) &
Cdbl(dteTest), , "Time"
```

VB CODE COMPLIANCE

Dates in Visual Basic code can be used as input, in calculations, or as output. Dates manipulated in code have the greatest potential for trouble, so let's look at them first.

The Date data type was introduced to Visual Basic in Version 4.0. Prior to that, VB used a Variant type of V_DATE, or 7. Internally, VB dates are actually double-precision floating-point numbers 8 bytes in length, and they can represent dates from January 1,

Dates converted using CDate and CVDate use the method outlined in the table on the left, which means that 32-bit applications running on recent versions of Windows use the windowing technique with a window of 1930 to 2029. Unfortunately, however, VB's DateSerial function uses the current century when interpreting two-digit year values.

If dates were always entered, stored, and manipulated as Date variables, there wouldn't be much of a problem. But dates are often handled in code as character strings, in which the two leftmost characters might indicate the year. Even worse, some companies build meaningful values (such as order numbers) that incorporate dates and may use codes embedded in the year to indicate some special status.

You should look out for code that manipulates dates as strings using VB's Left\$, Mid\$, and Right\$ functions to break and reassemble them from their constituent parts. In general, you should never manipulate dates as strings in your code. But if you do, you should convert the strings to Dates as soon as possible. After conversion, you can check the century using VB's Year function, like this:

```
Dim dteTest As Date
dteTest = Now

Select Case Year(dteTest)
    Case 1900 to 1999
        ...
    Case 2000 to 2099
        ...
    Case Else
        ' Problem?
        ...
End Select
```

Although VB's built-in date functions—DateAdd, DateDiff, DatePart, and DateValue—are useful for working with dates, you might want to look through your code for those functions to see if you've coded any related processing of dates as strings.

INPUT/OUTPUT

Dates can also be stored, exported to other programs, displayed on a screen, or printed in reports. They can be entered with a keyboard, pulled from a database, or taken as input from an external program. Whether dates are used as input or output, the basic issue is the same as for calcula-

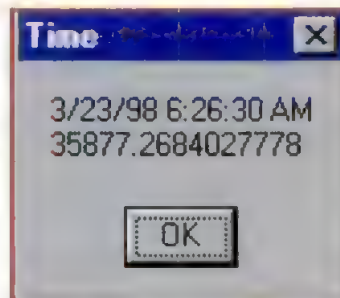


FIGURE 2: The value of a Date variable displayed as a Double.

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tions: potentially incorrect handling of two-digit year values.

If programs used four-digit values for years in everything involving dates, there wouldn't be a problem. Unfortunately, space on accounting screens and reports is tight, many external systems produce or expect two-digit years, and users can save time and typing by entering two-digit years.

In some cases, there's really no problem at all. A data entry operator can determine the right century and not be confused by years ending in 00. But in other cases, you'll have to modify screens and reports to display and print complete years. In your own code, you should look for VB's `Format$` function, which uses custom formats or the predefined `Short Date` format to output two-digit years. Text boxes are most commonly used for entering dates on forms, but you should also take a look at `MaskedEdit` controls (which have a `Text` property that returns either a `Variant` or `String`, depending

on the version), `Access` calendar controls (which have both `Year` and `Date` properties, with `Date` accepting two digits for the year), and any third-party controls you use for entering dates.

Data-access code is actually a Y2K bright spot. SQL has always been a Y2K-compliant language, and all modern databases have internal data types. For the most part, code that works with dates stored in databases won't have any problems. The exception is code that, like VB's string-manipulation functions, specifically manipulates two-digit years. Most often this will show up in a SQL `WHERE` clause, like

```
...WHERE ((Right([Order Date],2)>99));
```

WINDOWING OR CURRENT CENTURY?

The 16-bit versions of Visual Basic (Versions 1.0 to 3.0 and the 16-bit release of Version 4.0) all assign two-digit years to the current century. The 32-bit versions rely on the

OLE Automation Library to determine the date window. Since VB 5 requires the updated `Oleaut32.dll`, code developed with that version can assume a window from 1930 to 2029 for two-digit years. With 32-bit VB 4, however, it's necessary to determine the DLL's version dynamically, using code, like that in Figure 3, that finds each of the file version values and displays a message box (Figure 4).

Y2K TOOLS

Tools for solving Y2K problems can range from simple, general-purpose Unix-based utilities like `grep` all the way up to \$25,000 planning programs. While most tools in the latter category are COBOL-specific, others are more general in scope or are targeted specifically for use with VB. Almost all tools that work with VB code operate on the ASCII versions of VB source files. That could be an issue for you, since Version 1.0 of VB used only binary files, and projects brought for-

```
Declare Sub CopyMemory Lib "kernel32" Alias
"RtlMoveMemory"
(lpvDest As Any, _
ByVal lpvSource As Long, _
ByVal cbCopy As Long)
Public Declare Function GetFileVersionInfo Lib
"version.dll"
Alias "GetFileVersionInfoA" _
(ByVal lptstrFilename As String, _
ByVal dwHandle As Long, _
ByVal dwLen As Long, _
lpData As Byte) As Long
Public Declare Function GetFileVersionInfoSize Lib
"version.dll" Alias "GetFileVersionInfoSizeA" _
(ByVal lptstrFilename As String, _
lpdwHandle As Long) As Long
Declare Function VerQueryValue Lib "version.dll" Alias
"VerQueryValueA" _
(pBlock As Byte, _
ByVal lpSubBlock As String, _
lpIpBuffer As Long, _
puLen As Long) As Long

Type VS_FIXEDFILEINFO
dwSignature As Long
dwStrucVersionl As Integer ' e.g. = &h0000 = 0
dwStrucVersionh As Integer ' e.g. = &h0042 = .42
dwFileVersionMSl As Integer ' e.g. = &h0003 = 3
dwFileVersionMSh As Integer ' e.g. = &h0075 = .75
dwFileVersionLSl As Integer ' e.g. = &h0000 = 0
dwFileVersionLSh As Integer ' e.g. = &h0031 = .31
dwProductVersionMSl As Integer ' e.g. = &h0003 = 3
dwProductVersionMSh As Integer ' e.g. = &h0010 = .1
dwProductVersionLSl As Integer ' e.g. = &h0000 = 0
dwProductVersionLSh As Integer ' e.g. = &h0031 = .31
dwFileFlagsMask As Long ' = &h3F for version "0.42"
```

```
dwFileFlags As Long ' e.g. VFF_DEBUG Or
VFF_PRERELEASE
dwFileOS As Long ' e.g. VOS_DOS_WINDOWS16
dwFileType As Long ' e.g. VFT_DRIVER
dwFileSubtype As Long ' e.g. VFT2_DRV_KEYBOARD
dwFileDateMS As Long ' e.g. 0
dwFileDateLS As Long ' e.g. 0
End Type
```

```
Sub GetVer(sFile As String, ffi As VS_FIXEDFILEINFO)
Dim lVSize As Long
Dim dwHandle As Long
Dim lpData As Long

Dim lpVer As Long
Dim arVerBuff() As Byte

lVSize = GetFileVersionInfoSize(sFile, 0&)
ReDim arVerBuff(lVSize)
lRet = GetFileVersionInfo(sFile, 0&, lVSize,
arVerBuff(0))
lRet = VerQueryValue(arVerBuff(0), "\", lpVer, 0&)
CopyMemory ffi, lpVer, Len(ffi)
End Sub
```

```
Sub Main()
Dim ffi As VS_FIXEDFILEINFO
Dim sFileName As String

sFileName = "OLEAUT32.DLL"
GetVer sFileName, ffi
MsgBox ffi.dwFileVersionMSh & "." &
ffi.dwFileVersionMSl & "." &
ffi.dwFileVersionLSh, , "Version"
End Sub
```



FIGURE 3: With 32-bit VB4, you need to determine the version of `Oleaut32.dll` dynamically.

ward to later versions may still be saved as binary as a settable option.

The tools below search for built-in lists of date-related strings and can also be customized to include additional strings (like the names of library functions or variables), based on your organization's coding practices. The tools can do preliminary string searches against source code and database schemas and can give you a useful snapshot of where to begin making the changes that will bring your code into Y2K compliance.

Date Analyzer, from Expert Information Systems (www.sgw1.demon.co.uk/year2000/index.htm), is an add-in that works only in VB 4 (both 16- and 32-bit versions). It can analyze VB 3 projects.

FindDate, available from NIST (www.nist.gov/y2k/), is a public-domain command line utility that searches a list of files (you can use wildcards) for common date-related strings. The program produces a summary report like the following:

```
FILE: D:\PROJ\ASA\ASAEAM\STARTUP.BAS
149 YEAR > IYEAR% =
GETPRIVATEPROFILEINT("DEFAULTS",
"YEAR", 0, INIFILE%)
150 DATE > IF YEAR(DATE) >= IYEAR%
THEN
151 DATE > IF MONTH(DATE) > 7 THEN
152 YEAR > MSG$ = "THIS TEST EXPIRES
SEPTEMBER 1, " & STR$(IYEAR%) & "."
172 MINUTE > IMINUTES =
GETPRIVATEPROFILEINT("PARAMS",
"MINUTES", 0, INIFILE%)
180 LINES SEARCHED. 6 WITH APPARENT
DATE/TIME HITS
```

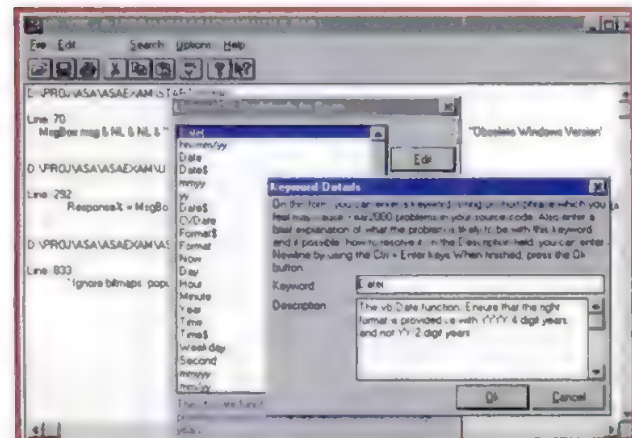


FIGURE 5: VB_Y2K can search VB source code to help you identify possible year 2000 problem areas.

VB_Y2K, currently in beta release from Brighton Beach Software (www.bbs.com.au/bbs/vb_y2k.htm), understands only VB 3 project files, though it can scan any ASCII text file. The program can extract source lines as strings, which can then be saved or printed (Figure 5).

Visual DateScope 2000, from Class Solutions (www.class-solutions.com), includes a parsing engine as well as support for impact analysis, remediation, and testing. The product handles Visual Basic Versions 3, 4, and 5 as well as VBA code stored in Access databases and Excel spreadsheets. A demo version of the tool (limited to 5,000 lines of code) is at www.class-solutions.com/version2.htm.

Year 2000 Detective, from Windsor Software (www.windsorsoftware.com), checks source code and generates reports. The program supports VB 4 and VB 5.

SUMMARY

It's not enough to update your code and components to be Y2K-compliant. To have confidence that a given system is going to operate properly after 1999, you must set your clock ahead and perform exhaustive tests. Unfortunately, that isn't as simple as it sounds. First you must take a snapshot of your existing data and "age" it appropriately. Setting the clock ahead could trigger the expiration of any software in your system with built-in time limits. You could even cause such software to be permanently disabled. And if your system uses digital certificates, as is typical for Internet applications, you could render those certificates invalid.

For more information on making your VB applications Y2K-compliant, you might want to take a look at Microsoft's Year 2000 FAQ (www.microsoft.com/cio/articles/year2000faq.htm) as well as Knowledge Base article Q162718, "HOWTO: Prepare Visual Basic Applications for the Year 2000." **PC**

Keith Pleas is an independent author, developer, and trainer. He organizes and speaks at technical conferences and is a contributing editor of Visual Basic Programmer's Journal.

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Dissecting the Heart of Your Computer

In this first part of a three-part series, we take an in-depth look at exactly what a microprocessor is made of.

By Neil Randall

The central processing unit (CPU) is the heart of your computer. This vital component, often referred to simply as the *microprocessor* (or even just *processor*), is in some way responsible for every single thing your computer does. It determines, at least in part, which operating systems you can use, which software packages are available to you, how much energy your PC uses, and how stable your system will be, among other things. The processor also dictates how much your system will cost: The newer and more powerful the processor, the more expensive the machine.

In this and the next couple of Tutor columns, we'll take an in-depth look at microprocessors. We'll begin with a brief look at what a processor is made of, and then we'll turn to the different parts of the processor to see how they work. Next time we'll examine the Intel processor family, from the 4004 through the Pentium II, and before we finish we'll examine some other microprocessor families, including Intel clones.

THE MAKEUP OF A MICROPROCESSOR

You may think a processor is the square or rectangular piece with many pins that fits into the processor slot on your motherboard, but actually that is just the packaging that contains the processor. The processor itself is a small, thin chip of silicon crystal, typically less than half a square inch in area. The packaging both protects the processor from contaminants (such as the air) and allows it, through the pins, to engage the motherboard's circuits and hence the system as a whole. The millions of electronic switches (the transistors) inside the processor need a carefully controlled environment in which to function.

Although most processors are made of silicon, any semiconductor material will do, as long as it can be fabricated into high-quality pieces of the necessary size. Silicon is widely available and inexpensive because of its ubiquitous use, and it is therefore the most popular material. Silicon works well, because it can form large crystals of uniformly high quality; each crystal is about 8 inches across, which is important because manufacturers

want to cut each crystal into as many chips as possible. Precision saws cut the crystal into slices less than a millimeter thick. These slices, called *wafers*, are chemically treated before being cut into individual chips. The process for physically applying the logical design of the processor to the chip is called *photolithography*; in this step, transistors and tiny wires are built onto the chip in a series of ten or more layers (called *masks*). Once this layering is complete, the chip is tested several times to ensure that the transistors and wires are in place and working properly, and then the chip is placed within its packaging.

The packaging not only protects the chip but also dissipates heat and allows the proces-

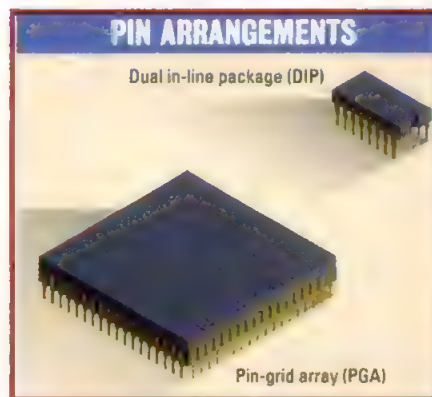


FIGURE 1: This shows the DIP and PGA designs, demonstrating why more pins are possible in a smaller space with the PGA.

sor to connect to the motherboard. Over the years packaging has changed considerably, with new methods adopted for various processor designs. The first Intel chips used *dual in-line packages* (DIPs), in which two parallel sets of 40 or more pins provided the connection to the motherboard (see Figure 1). Because of the parallel design, upgrades to this package could not accommodate significant expansion of connectors: The package would simply get too long for the motherboard as pins were added, and signals from the end pins would require much more time to reach the processor chip than signals from closer pins. For these reasons, the 80286 processor introduced the *pin-grid array* (PGA) package. This package is

typically square, with two, three, or even four rows of evenly spaced pins arranged around a central area. The pins fit into the corresponding holes of the socket module on the motherboard, and typically the package is locked in place by a levered arm.

The square (or squarish) package design that we are most familiar with began with the 80286 and has remained dominant. As the quest for more capable processors grew, wider buses were needed and consequently more pins were required to fit these buses, and many alterations of the package began to appear. Pentium processors use the *staggered pin-grid array* (SPGA) design, which staggers the arrangement of the pins to allow them to fit closer together. The Pentium Pro, because it has separate chips for the CPU and the Level 2 cache, uses a design called the *multi-chip module* (MCM). An MCM is a package that contains more than one chip. Another recent package, the *leadless chip carrier* (LCC), uses tiny contact pads of gold instead of pins to make contact with the motherboard.

Other packages include the *tape-carrier package* (TCP)—which is as thin as photographic film and is soldered to the motherboard—and the *single-edge contact* (SEC) cartridge, used for the Pentium II. This is actually a PGA package mounted on a small daughter-card that attaches to the motherboard through a single-edge connector. The SEC is a highly appealing design, because it takes up less space on the motherboard and has better electrical characteristics.

INSIDE THE PROCESSOR

Fundamentally all processors do the same thing. They take signals in the form of 0s and 1s (thus *binary* signals), manipulate them according to a set of instructions, and produce output in the form of 0s and 1s. The voltage on the line at the time a signal is sent determines whether the signal is a 0 or a 1. On a 3.3-volt system, an application of 3.3 volts means that it's a 1, while an application of 0 volts means it's a 0.

Processors work by reacting to an input of 0s and 1s in specific ways and then returning an output based on the decision. The decision itself happens in a circuit called a *logic gate*, each of which requires at least one transistor, with the inputs and outputs arranged differently by different operations. The fact that today's processors contain millions of transistors offers a clue as to how complex the logic system is. The processor's logic gates work together to make decisions using Boolean logic, which is based on the algebraic system established by mathematician George Boole. The main Boolean operators

are AND, OR, NOT, and NAND (not AND); many combinations of these are possible as well. An AND gate outputs a 1 only if both its inputs were 1s. An OR gate outputs a 1 if at least one of the inputs was a 1. And a NOT gate takes a single input and reverses it, outputting 1 if the input was 0 and vice versa. NAND gates are very popular, because they use only two transistors instead of the three in an AND gate yet provide just as much functionality. In addition, the processor uses gates in combination to perform arithmetic functions; it can also use them to trigger the storage of data in memory.

Logic gates operate via hardware known as a switch—in particular, a digital switch. In the good old days of room-size computers (which looked lots more impressive in movies than today's machines), the switches were actually physical switches, but today nothing moves except the current itself. The most common type of switch in today's computers is a transistor known as a MOSFET (metal-oxide semiconductor field-effect transistor). This kind of transistor performs a simple but crucial function: When voltage is applied to it, it reacts by turning the circuit either on or off. Most PC microprocessors today operate at 3.3V, but earlier processors (up to and including some versions of the Pentium) operated at 5V. With one type of MOSFET—which will be the focus here—an incoming current at or near the high end of the voltage range switches the circuit on, while an incoming current near 0 switches the circuit off.

Millions of MOSFETs act together, according to the instructions from a program, to control the flow of electricity through the logic gates to produce the required result. Again, each logic gate contains one or more transistors, and each transistor must control the current so that the circuit itself will switch from off to on, switch from on to off, or stay in its current state.

A quick look at the simple AND and OR logic-gate circuits shows how the circuitry works (see Figure 2). Each of these gates acts on two incoming signals to produce one outgoing signal. *Logical AND* means that both inputs must be 1 in order for the output to be 1; *logical OR* means that either input can be 1 to get a result of 1. In the AND gate, both incoming signals must be high-voltage (or a logical 1) for the gate to pass current through itself. Notice in Figure 2 how a high voltage must be applied to both of the transistors in this gate in order for the circuit to be completed. Otherwise the circuit will remain turned off, giving

you a logical 0. In the OR gate, as long as either incoming current is high, the gate will allow the current through. Notice in Figure 2 how if a voltage is applied to either transistor, the circuit will be completed.

The flow of electricity through each gate is controlled by that gate's transistor. However, these transistors aren't individual and discrete units. Instead, large numbers of them are manufactured from a single piece of silicon (or other semiconductor material) and linked together without wires or other external materials. These units are called *integrated circuits* (ICs), and their development basically made the complexity of the microprocessor possible. The integration of circuits didn't stop with the first ICs. Just as the first ICs connected multiple transistors, multiple ICs became similarly linked, in a process known as *large-scale integration* (LSI); eventually such sets of

processors have 32-bit register sizes, and 64-bit processors have double that. The greater the number of bits in a register, the more information the processor can process at once.

The processor spends its time reacting to signals, but it can't react to all of them at the same time or they would become jumbled. Instead, the processor waits until it is given the go-ahead to receive a signal; how long it waits is determined by the system clock. At precise intervals, the system clock sends electrical pulses as a means of polling the system for waiting instructions. If an instruction is waiting and the processor is not already busy with previous instructions, the processor brings the instruction in and works on it. The number of instructions the processor can handle in a single clock cycle (one pulse of the system clock) depends on the design of the processor itself.

The first microprocessors were able to handle only one instruction per cycle, but today's processors speed this up considerably through two processes, called *pipelining* and *superscalar execution*. Pipelining allows the processor to read a new instruction from memory before it is finished processing the current instruction. In some processors, several instructions can be worked on simultaneously. The extent to which pipelined data can flow into the processor is called the *pipeline depth*. Up through the 80286, Intel processors had a pipeline depth of only 1 (in effect, there was no pipeline at all), but with the 80486 family, the pipeline depth jumped to 4; up to

four instructions could be in different pipeline stages. Pentiums have a pipeline depth of 5, and MMX technology enables even more.

A superscalar processor has more than one pipeline, meaning it can execute more than one set of instructions at the same time. Theoretically this can double performance, but usually one of the pipelines ends up waiting for an instruction to finish in another pipeline.

AND ON TO THE NEXT TIME

Since the processor's entire purpose is to execute instructions, understanding them is crucial to understanding the processor concept. In the next installment of this column, we'll look at instruction execution and instruction sets, briefly explore other important terminology, and dig into the Intel processor family. **PC**

Neil Randall is the author of *The Soul of the Internet (ITCP)* and *Special Edition Using Microsoft FrontPage98 (Que)*.

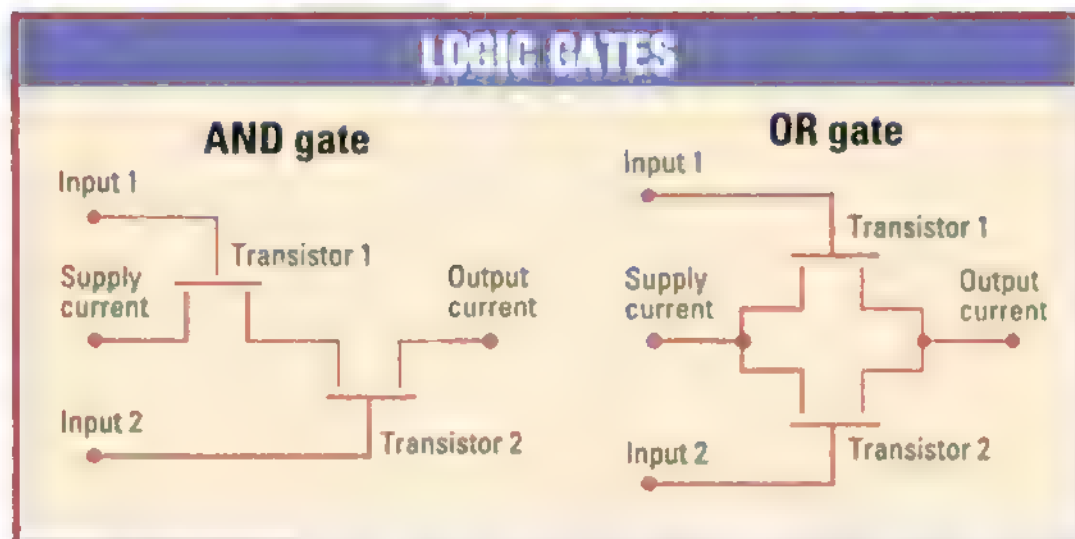


FIGURE 2: The AND and OR logic gates. In the AND gate, a voltage must be applied to both inputs (and therefore both transistors) in order to maintain a current from the supply to the output and thus produce a logical 1. In the OR gate arrangement, only one of the inputs needs to have a high voltage in order to maintain the current from the supply to the output to yield a logical 1.

ICs were connected, in a process called (using the industry's deeply creative naming techniques) *very large-scale integration* (VLSI). Intel's first claim to fame lay in its high-level integration of all the processor's logic gates into a single complex chip. The first processor to do this was the Intel 4004, the forerunner of all of today's Intel offerings. We'll look at the 4004 and its descendants next time.

Two of the most crucial components of the processor are the *registers* and the *system clock*. A register is an internal storage area, a unit of memory; and because it is part of the processor, it has the fastest type of memory in your system. Its function is to hold data used by instructions, in the form of *bit patterns* (sequences of 0s and 1s), in specific places where the processor can find them. The importance of the registers is demonstrated by the fact that processors are identified in one significant way by register size. The term *16-bit processor* refers to a processor with registers capable of holding 16 bits of data. Therefore, 32-bit

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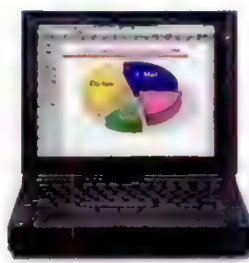
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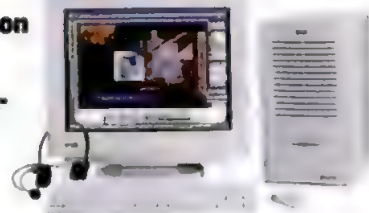
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DirectShow and DVD

The pros and cons of programming DVD with DirectShow and how you can use DVD in your apps.

By Linden deCarmo

Extending the Media Control Interface (or MCI) to support DVD is equivalent to trying to patch a gushing wound with a Band-Aid. In our January 6, 1998, Operating Systems column, "A New Architecture for Multimedia," we came to the conclusion that DirectShow was the only realistic solution for emerging technologies such as DVD. In this article, we will examine how DVD works in DirectShow, reveal the advantages possible only with DirectShow, and explore how you can use DVD in your programs.

A recent research report by Forrester (see the Web page references at the end of this article) came to a startling conclusion: DVD will shift the entertainment balance of power from consumer electronic devices to computers. Nevertheless, few users understand the technology behind DVD or even what DVD means. (DVD originally meant digital video disk, but it has become a self-standing term; it is no longer used as an acronym.) In fact, most people mistakenly believe that a DVD disk is simply a huge CD-ROM. In reality, there are two different categories of DVD content: DVD-ROM and DVD-Video. A DVD-ROM is capable of storing approximately 18 gigabytes of information—roughly 30 times the capacity of a CD-ROM—and there are no restrictions on the type of content or compression technologies that may appear on a DVD-ROM.

By contrast, DVD-Video disks follow a rigorous specification of the directory structure and multimedia content that may appear on them (this specification is referred to as *DVD Specifications for Read-Only Disc*). Virtually all DVD disks utilize MPEG-2 video, because MPEG-2 offers dramatically higher picture quality than current video-compression technologies. DVD-Video disks in North America contain either Dolby Digital (formerly known as AC-3) or uncompressed Pulse Code Modulation (PCM) audio tracks. DVD also has built-in caption support, which can be used for foreign-language subtitles or for closed captions for

the hearing-impaired. Additional technical details on DVD-Video can be found in my article in the June 1997 issue of *Game Developer* magazine, entitled "DVD: A Game Developer's Survival Guide."

The vast majority of DVD content will be released in DVD-Video format, because this is the only format that is common to consumer and computer players. If you wish to create a DVD-Video-enabled program, you have two options: use a stop-gap, MCI-based solution or the newly created DVD interfaces for DirectShow. Because the creators of the MCI alternative acknowledge that it will have a limited life span, we will focus this article on the functionality available with DirectShow.

THE BASIC INTERFACES

There are three primary interfaces used to manipulate DVD playback in DirectShow: *IDvdGraphBuilder*, *IDvdInfo*, and *IDvdControl*. *IDvdGraphBuilder* eases the complex task of constructing DVD graphs (networks

plex than constructing a graph with older multimedia technologies, because at least three multimedia filters are involved (AC-3, MPEG-2 video, and Subpicture). *IDvdGraphBuilder* not only constructs a DVD graph, it gives you access to the *GraphBuilder* object it creates on your behalf, supports the *RenderDvdVideoVolume* method, and provides a means to access the *IDvdInfo* and *IDvdControl* interfaces.

The first method you should use in *IDvdGraphBuilder* is *RenderDvdVideoVolume*, which constructs a DVD graph. The *lpwpszPathName* parameter informs the DVD subsystem where to play the DVD-Video disk. The *dwFlags* parameter enables you to influence the performance of the graph before it's constructed. For instance, if your application is performance-sensitive, you may want to use the *AM_DVD_HWDEC_ONLY* flag. This will ensure that no software decoders will be used in constructing the graph. By contrast, if you use the *AM_DVD_SWDEC_ONLY* flag, no hardware decoders can be used in creating the graph.

In reality, most applications will use the *AM_DVD_HWDEC_PREFER* or the *AM_DVD_SWDEC_PREFER* flag. *AM_DVD_HWDEC_PREFER* indicates that the program wants hardware decoders but that if none are available, it will grudgingly accept a software decoder. Similarly, *AM_DVD_SWDEC_PREFER* causes DirectShow to try software decoders first, but if none are found, it will accept a hardware decoder.

THE DVD DIFFERENCE

If you examine Annex J of the DVD specification, you'll notice that the *IDvdControl* interface is closely modeled after the required functionality for a DVD player. For instance, it contains methods for title and playback control, button manipulation, time searches, stream manipulation, and parental enforcement.

Each DVD disk contains 1 or more titles (up to a maximum of 99), and every title is divided into 1 or more chapters. The *TitlePlay* and *ChapterPlay* methods let you determine the starting title and chapter for a presentation.

User interaction is the primary difference between DVD-Video and videotape. For example, certain movies may change their endings based on user preference. DVD accomplishes this interactivity via buttons and menus.

DVD menus do not have to contain dry text

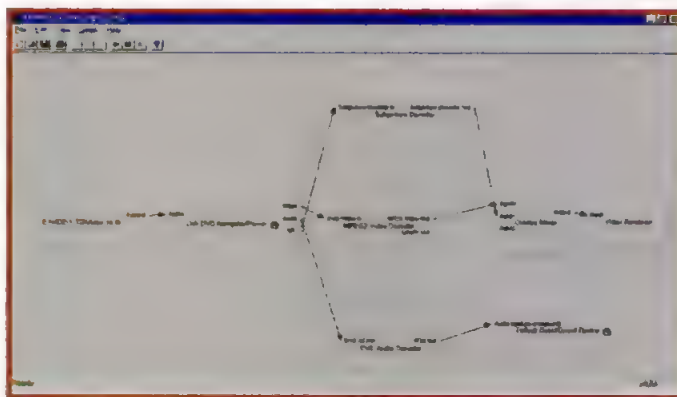


FIGURE 1: A sample DirectShow DVD graph created with the Filter Graph editor.

of DVD filters that process multimedia data). *IDvdControl* is designed to manipulate the state of the DVD player, while *IDvdInfo* is primarily used to obtain the status of the DVD subsystem.

Creating even a trivial, audio-only graph can be arduous. Fortunately, Microsoft created the *IDvdGraphBuilder* interface (which most DVD vendors supply with their products) to construct most common graphs for you (Figure 1 shows a sample DVD graph). Creating a DVD graph is vastly more com-



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screens; rather, they may contain motion video (for example, Warren Miller Ski World, from Multicom Publishing) or background audio tracks (Austin Powers, from New Line Home Video). The `MenuCall` method stops the current presentation and displays the requested menu screen. Every disk may potentially contain separate menu controls for title, chapter, audio, caption, and the disk, and each menu can be as simple as a text screen or as complicated as a feature-length movie with motion and graphics.

You can navigate through buttons in a menu or within a title with `UpperButtonSelect`, `LowerButtonSelect`, `LeftButtonSelect`, and `RightButtonSelect`. `ButtonActivate` causes the current button to be selected, while `ButtonSelectAndActivate` activates a specific button number (activation causes a command associated with a button to be executed).

In order to enhance interactivity, DVD-Video offers a multitude of options for searching through a disk's titles. The most useful of these methods is `TimeSearch`. It allows you to specify a starting presentation time within a linear title (DVD titles may be presented in a linear fashion or in a random sequence).

A much-hyped feature of DVD is that each title can support more than one audio or caption stream. For instance, a disk can contain English, French, and Spanish audio tracks and, as an added bonus, an audio track for directors' comments. You can select the audible audio track via `AudioStreamChange`. Likewise, `SubpictureStreamChange` can be used to change the active caption stream.

Parents can lock the DVD subsystem so that children cannot view content that's violent or of an adult nature. When a parent or guardian wishes to view such content, the `ParentalLevelSelect` method can be used to bypass these restrictions. Before you panic at the ease of bypassing parental restrictions, note that if the parental control is password-protected, `ParentalLevelSelect` will request the password before modifying parental restrictions.

COMPUTER-SPECIFIC METHODS

Aside from the methods that must be implemented on all DVD players, `IDVDControl` contains computer-specific methods. For example, the `MouseActivate` and `MouseSelect` methods let applications select buttons based on mouse position or the pressing of a mouse button. Another interesting method is `ChapterPlayAutoStop`. It lets you determine the number of chapters in a title to play before stopping playback. Without use of this option, the DVD subsystem will advance

through each chapter until it reaches the end of the title.

Once you've used `IDvdControl` to start playback, `IDvdInfo` can be used to track the status of title playback. Unlike `IDvdControl`, `IDvdInfo` is unique to `DirectShow`, and there is no equivalent to it in the DVD specification. It provides methods to obtain title information, player state, stream status, and button condition and to control user operation.

The first type of information available with `IDvdInfo` is an analysis of a title. `GetTotalTitleTime` returns the total amount of time that a title will play. `GetNumberOfChapters` informs you about the number of chapters that a specific title contains.

A second category of information `IDvdInfo` provides is the player state. `GetCurrentDomain` retrieves the active domain for the DVD player (see "DVD: A Game Developer's Survival Guide" for a description of DVD domains). `GetCurrentLocation` reports the active title and chapter and the current playback time within the title. `GetAllSPRMs` and `GetAllGPRMs` return the values of the internal registers of the DVD-Video subsystem (or software representation of a DVD player).

`IDvdInfo` is also used to uncover information about the currently playing audio, video, and subpicture streams. For example, `GetCurrentSubpicture` returns the stream number associated with caption data. Since many users are annoyed by text captions, most turn caption display off; therefore, `GetCurrentSubpicture` also indicates whether the caption is visible. Once you know the subpicture-stream number, `GetSubpictureLanguage` will let you know the actual language the caption will be displayed in. Similarly, `GetCurrentAudio` returns the active audio-stream number, and `GetAudioLanguage` reports the language for the stream.

The `GetCurrentButton` method enables your application to process DVD buttons intelligently. This method informs you of the total number of available buttons and the currently active button number. It should be used in concert with the button-manipulation methods of `IDvdControl` (such as `MouseActivate` and `MouseSelect`) to support button selection with the mouse. For performance reasons, your application should only send button-selection requests when buttons exist. Otherwise, you'll waste valuable processing power trying to select nonexistent buttons. To learn about a quirk in DVD buttons, see the sidebar entitled "A Button Bug."

Although few people realize this, DVD disks may completely control your application. DVD content can dictate which methods in `IDvdControl` you can use and when you can use them. The disk accomplishes this control via flags called *user operations*. If a particular bit in the user operations is set, the method corresponding to this bit cannot be used. Since every DVD player must enforce user operations, you can issue the `GetCurrentUOPS` call to retrieve the active user operations.

As an aside, many programmers feel that user operations are eerily like Big Brother in George Orwell's *1984*, and in some respects, they may be correct. User operations can prevent applications from fast forwarding through commercials or FBI warnings about pirating and so on. Although this may initially seem repulsive, it ensures that the content will be viewed in the manner that the author intended.

DVD EVENTS

Besides the DVD interfaces, `DirectShow 2.0` defines DVD-specific events. As we discussed in the earlier article, correct processing of these events is critical for DVD-enabled appli-

A Button Bug

One little-known but troublesome problem with the DVD specification is that buttons are logical entities that do not have to be synchronized with the video picture or even visible. Some early titles assumed that only remote controls would be used for button selection; as a result, on-screen buttons were positioned in weird locations, since the content assumed the player would issue button calls via commands such as `UpperButtonSelect`. Such remote-oriented calls select buttons via logical

numbers and do not care about button coordinates.

When these titles are played in a GUI environment and the user clicks on the location where the button should be, no button selection occurs. This happens because the button's window coordinates are located elsewhere. Although there is no remedy for this situation, very few titles contain this bug. Some titles with odd button placement are *Chic Live in Japan*, *A Christmas Story*, *Species*, and *Thelma and Louise*.—LD

cations. A DVD disk can dynamically modify the title it's presenting based on user input or instructions embedded in the content. Fortunately, these events let your application monitor when they occur.

DVD events can be divided into the following categories: *title*, *stream*, *attribute*, and *user operation*. Title-related events (such as `EC_DVD_TITLE_CHANGE` or `EC_DVD_CHAPTER_START`) are sent when the navigational filter changes chapters or titles.

Every presentation can have one or more audio and caption streams associated with it. When the DVD subsystem changes the active audio stream, it sends your program the `EC_DVD_AUDIO_STREAM_CHANGE` event. Similarly, the `EC_DVD_SUBPICTURE_STREAM_CHANGE` event is raised each time the current caption (or subpicture) stream is changed.

The next class of events consists of the attribute events. These events alert you when a significant change has occurred in the current video presentation. For example, `EC_DVD_ANGLE_CHANGE` is sent when the current viewing angle has changed (certain DVD content supports multiple camera angles for a given scene). Likewise, the `EC_DVD_STILL_ON` event is sent when the content has paused itself (usually to receive user input), and `EC_DVD_STILL_OFF` is sent when the pause is complete.

User operations are the final type of event; `EC_DVD_VALID_UOPS_CHANGE` will be sent whenever user operations change on the disk. You should carefully monitor this event, because it dictates which methods in `IDvdControl` are legal to use.

DIRECTSHOW DRAWBACKS

Although DirectShow enables DVD on Win32 platforms, it is the first release of the API. As a result, it has some irritating weaknesses, which will grate on you as you use it. First, the interface that Microsoft has designed often refers readers to the *DVD Specifications for Read-Only Disc* to obtain essential programming information (such as information about the processing of video attributes). Since *DVD Specifications for Read-Only Disc* costs \$5,000, this pseudo-requirement may prevent casual programmers and shareware authors from using DirectShow. Other DirectShow DVD programming tools provide a more effective solution to this problem by abstracting these interfaces, thereby shielding the programmer from lower-level details.

Second, as it has done with its Java implementation, Microsoft has made minor deviations from the standardized player interface defined by the DVD specification. Besides

going against the spirit of the specification, this creates headaches for the programmer. For example, instead of using ISO 9660 codes for languages and countries, Microsoft has decided to use Windows-based Language Code IDs (or LCIDs). Because Win32 uses LCIDs, this may initially seem to ease the programmer's task. Unfortunately, many DVD API functions implicitly rely on ISO 9660 codes; therefore, DirectShow-based programs could contain a hodgepodge of LCID and ISO 9660 conversions.

Finally, the Microsoft implementation of the DirectShow interface has no backward compatibility and is completely incapable of playing non-DVD-Video content. Many software vendors have software titles that utilize older MPEG-1 and MPEG-2 content or the MPEG/AC-3 content found in VOB files. Unfortunately, the Microsoft implementation of DVD in DirectShow 2.0 has no solution for these vendors. This restriction is not an architectural one, as other vendors provide DirectShow DVD environments that can play MPEG-1, VOB, and even VideoCD content.

The computing environment will be the driving force behind DVD's success, and the DVD interfaces defined in DirectShow 2.0 will be the agents for this triumph. These interfaces enable you to control a DVD-Video disk, monitor playback status, and be automatically notified when the content changes status. Despite current limitations in both DirectShow and the DVD specification, we can expect the advent of broadcast-quality interactive multimedia content as these technologies evolve.

WEB SITES OF INTEREST

- The finding that DVD will shift the entertainment balance of power to the PC: www.forrester.com (see the article entitled "DVD's New Content Model"; guest registration required).
- MCI-to-DirectShow transitions: www.intel.com/solutions/tech/dvd/dvd_wh2.pdf.
- The Intel DirectShow DVD resource page: www.intel.com/solutions/tech/dvd.htm.
- DVD and Microsoft operating systems: www.microsoft.com/hwdev/devdes/dvdwp.htm.
- The Software Publishers Association's DVD recommendations: www.spa.org/dvd/default.htm.
- The Ultimate DVD Resource Page: www.unik.no/%7Erobert/hifi/dvd/ 

Linden deCarmo, a frequent contributor to PC Magazine, is a staff software engineer at Oak Technology. You can contact him at lindend@ibm.net.

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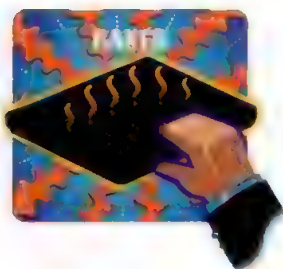


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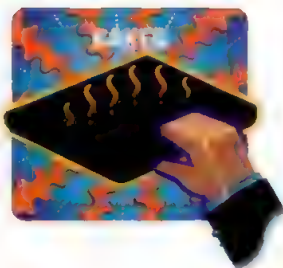
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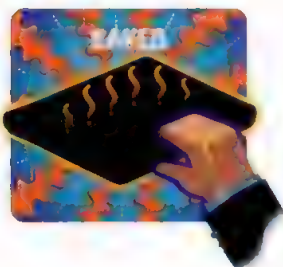
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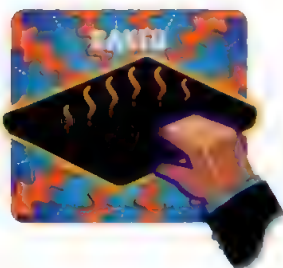
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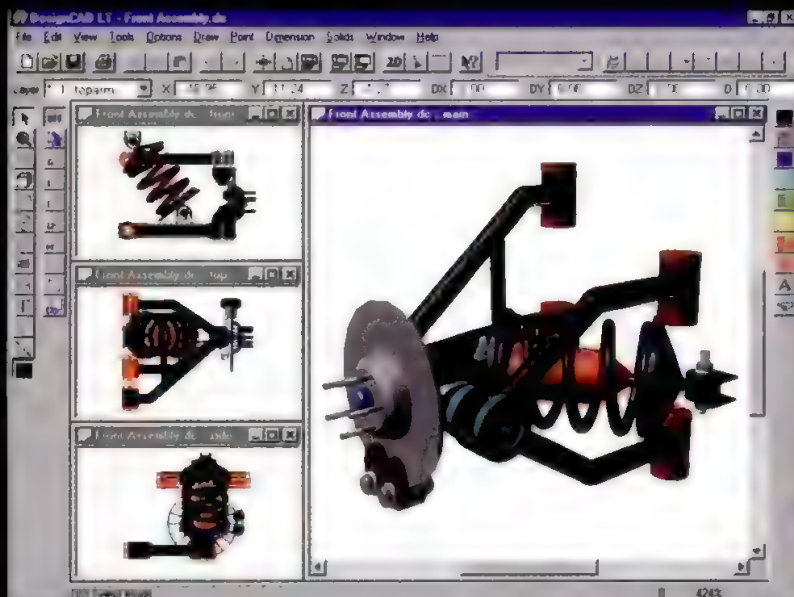


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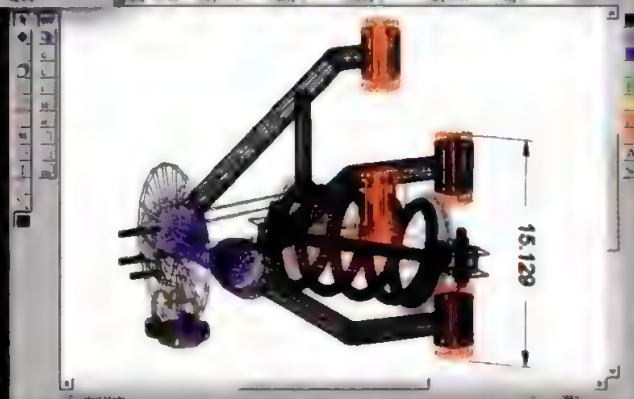
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Avoid the DOS Prompt!

MultiRen lets you rename groups of files from within Windows Explorer.

By Gregory A. Wolking

Windows Explorer has many strengths, but it lacks an important feature—the ability to rename several files with a single command. The only method Windows provides to rename multiple files is the DOS `ren` command. Not only is this unfriendly, it's limited in capability. The `ren` command can use wildcards to provide a crude sort of search-and-replace, but it can't do much else.

This issue's utility, MultiRen, enhances Windows Explorer with a sophisticated feature called Multiple Rename. It runs under Windows 95 and Windows NT 4. To access MultiRen, select two or more files from within Explorer, right-click for the context menu, and select *Multiple Rename*. In addition to the standard wildcard characters, MultiRen supports special commands that add sequence numbers to filenames, force uppercase or lowercase, and more.

You can obtain MultiRen for free by download from PC Magazine Online or by mail. Refer to the sidebar "How to Get the Files" for details. MultiRen was written in C++ with Microsoft Foundation Classes (MFC). The source code is included with the program for those interested in seeing how it works.

USING MULTIREN

To install MultiRen, place its component files (MultiRen.exe, MultiRen.hlp, MultiRen.cnt, and MRsetup.exe) in the directory of your choice. Launch MRsetup.exe, then click the *Install MultiRen* button. MultiRen is now ready to use. The program neither requires nor creates any additional files, though it does create some registry entries. To remove MultiRen from your system, use the *Add/Remove Programs* ap-

plet in Control Panel, or run MRsetup.exe again and choose *Remove MultiRen*. Either way, MRsetup.exe will remove all of MultiRen's information from the system registry. Once that's done, you can complete the removal by deleting MultiRen's files.

There is no obvious evidence immediately after installation that MultiRen is present. To see MultiRen in action, first select a group of files in Explorer. Right-click on any of the files in your selection and you will see a *Multiple Rename* command on the pop-up menu. You can use this command almost anywhere you can select files in Windows. This includes the file lists in the standard *File | Open* and

- All of the objects in your selection must be physical files. MultiRen cannot rename folders or shell objects such as My Computer or Network Neighborhood.

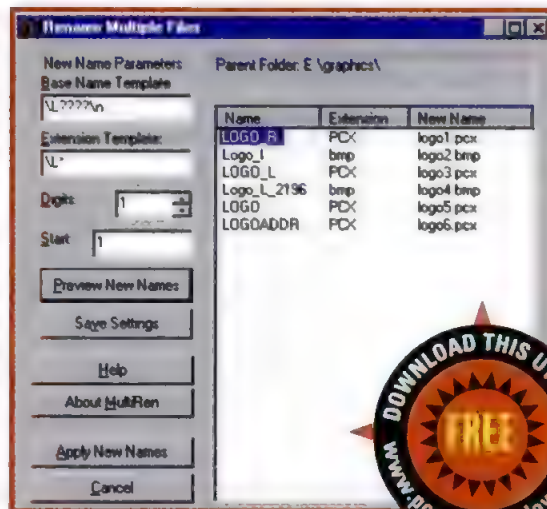
- The folder in which your selected objects reside cannot be a special system folder such as Fonts, History, Temporary Internet Files, or Recycle Bin.

- If you select files from the *Find* command's results list, all of the files in your selection must reside in the same folder. MultiRen does not attempt to rename files that are stored in different folders.

When you select the *Multiple Rename* command, MultiRen's dialog appears (see the screenshot on the left). The controls on the left side of the dialog let you tell MultiRen how to generate your new names. The list on the right shows the original names and your new names. When you make changes to the template or numbering fields, you must press Enter or click the *Preview New Names* button

to see the changes reflected in the file list. When the file list shows the new names that you want, click the *Apply New Names* button to rename the files as specified. Note that the changes may not be visible until you refresh the display in the original window.

MultiRen provides full online help. For general help, you can either press F1 or click the *Help* button. For pop-up help with a specific control in the dialog, right-click on either the control or its label and select *What's This?* from the pop-up menu.



THE MULTIREN templates shown here force lowercase in the new filename and add a sequence number.

File | Save dialogs and the *Find* command's results list.

Note that the *Multiple Rename* command will appear only when conditions are right. Specifically:

- You must have more than one object selected.

THE FILE LIST

The file list has three columns: Name, Extension, and New Name. Initially, your files will be listed in the order in which the system reports them. You can sort the list by either name or extension by clicking the button at the top of the appropriate column. Subsequent clicks on the same button reverse the sort order.

You may also rearrange the list manually by dragging files and dropping them in the desired positions. When you drop one file on another, the file you drop will be placed

For Programmers Only MultiRen is a 32-bit Windows shell extension written in C++ with Microsoft Foundation Classes (MFC). It can be compiled with Microsoft Visual C++ 5.0. The full source code for MultiRen is available from PC Magazine Online (www.pcmag.com) and demonstrates several interesting programming techniques, including how to:

- add drag-and-drop support to a CListBox control;
- provide custom features in an edit control;
- add keyboard-accelerator support to a dialog with no menu.

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immediately after the file you drop it on. If the destination is not visible, moving the mouse pointer above or below the list while dragging will scroll the list in that direction. To cancel a drag operation, you may either drop the file back on itself, drop the file while the mouse pointer is outside the list box, or click the right mouse button before releasing the left.

If your list of new names is valid, the status line immediately above the list will show the path to the current file's parent folder. If the list is not valid, the *Apply New Names* button will be disabled and the status line will show the reason.

USING TEMPLATES

MultiRen uses templates to build your new filenames. It automatically separates the base-name and extension portions of each original filename and uses a separate template for each portion.

Each character in a template can be either a literal or a command. Literals are characters that will be transferred directly to the new name without modification. Commands let you determine how (or whether) characters from the original name will be transferred to the new name (see Figure 2). Figure 3 shows some examples of template strings that use such commands.

MultiRen does not update the file list automatically as you edit the template fields. Doing so would make the program very sluggish, especially when the file list was very long or the templates were very complex. To update the list after editing your templates, either press Enter or click the *Preview New Names* button.

SEQUENCE NUMBERS

You can include sequence numbers in your new filenames by using the \N command in your base or extension templates to specify where the numbers will appear. The Digits field determines how many digits those numbers will contain; MultiRen automatically pads the sequence numbers with leading 0s, as needed. The Start field determines the sequence number that will be applied to the first file in the list. Sequence numbers are applied in order as the files appear in the list, from top to bottom. To change the sequence number associated with a specific file, drag that file to the desired position in the list.

As with the template fields, MultiRen does not update the list automatically when you edit the Digits or Start fields; you must either press Enter or click the *Preview New Names* button. However, the list will be updated automatically if you change the

Digits setting using the spin button.

To save your templates and Digits settings for use the next time you launch MultiRen, click the *Save Settings* button. If your current template and numbering settings are not valid, the *Save Settings* button will be disabled.

RENAMING YOUR FILES

Once the file list contains the new names you want, click the *Apply New Names* button to rename the files as specified. If the command is successful, the dialog closes and you are re-

try again. If you choose not to restore the original names, the dialog will close.

MultiRen is a fairly simple yet very powerful utility. I designed MultiRen to warn you before it does something potentially dangerous, such as renaming files in your System folder or renaming executable files anywhere on the system, but I cannot foresee every potential problem. Therefore, please be careful when you use MultiRen. I strongly suggest that you copy some of your files to a safe place and experiment with renaming

MULTIREN COMMANDS	
Command	Function
?	Works as a wildcard, transferring one character from the original name. If all characters in the original name have already been used in the new name, ? is replaced with a space.
*	Works as a wildcard, transferring all remaining characters from the original name. This command can be used only once in each template. If a template already contains an asterisk, MultiRen won't let you type a second one.
^	Discards a character from the original name.
\N	Represents the current sequence number. You can use \N more than once if you like. However, \N always represents the same sequence number for any given file.
\I	Toggles insert mode. By default, insert mode is off, so each literal character (including digits used for sequence numbers) in your template replaces the corresponding character in the original name. When insert mode is on, literals or sequence numbers are inserted into the new name without consuming characters from the old name.
\L	Toggles forced lowercase. This function is disabled by default; when it is enabled, any characters transferred via the ? and * wildcards are converted to lowercase.
\U	Toggles forced uppercase, working similarly to \L. Note that turning on \U turns off \L automatically, and vice versa.

FIGURE 2: These command characters and sequences have special meanings when used in MultiRen's template fields.

turned to the window where you made your selection. Note that it may take a couple of seconds for that window to be updated and show the new names.

The *Apply New Names* command always displays a warning and prompts you for confirmation before attempting to rename your files. The nature and severity of the warning varies depending on the circumstances. The warning is especially strong if you attempt to rename files located in your Windows or System directory or if any of the files in your list is an executable. You should not take these warnings lightly; renaming the wrong files can render your system completely inoperable.

Since the file list is not automatically updated as you edit the templates and numbering settings, it is possible for the list to be out of synch with those settings when you issue the *Apply New Names* command. If this happens, MultiRen will present a warning message, rebuild the list, and then return you to the dialog so you can review the updated list before trying the command again.

If any of the files in your list could not be renamed, MultiRen will give you the opportunity to restore all of your original names and

those copies until you get a feel for how MultiRen works.

INSIDE MULTIREN

I wrote MultiRen using Microsoft Visual C++, Version 5.0. Since shell extensions have been covered previously in *PC Magazine* (see the April 25, 1995, Power Programming column and the December 19, 1995, Utilities column), I won't focus on those basic details in this article. Instead, I will discuss how to add drag-and-drop support to a `CListBox` control, provide custom features in an edit control, and add keyboard support to a dialog with no menu.

THE LIST CONTROL

MultiRen uses a `CListBox` object, one of the new common controls included with Windows 95, to present the user's file list. While I could have used a standard list box for this, the list control made it a lot easier to format the list into columns, allow the user to sort on those columns, and allow the use of drag-and-drop to rearrange items in the list.

To add the drag-and-drop feature to the control, I used the Class Wizard to create my own `CMRListBox` class derived from `CList-`

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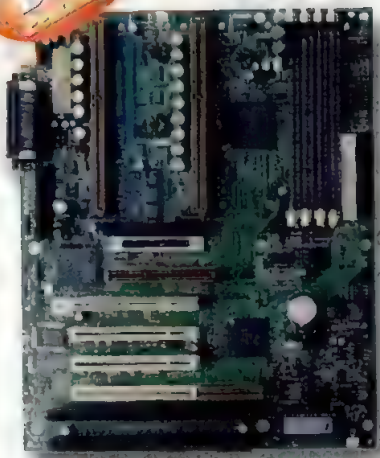


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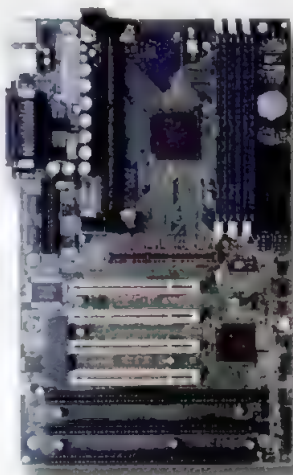


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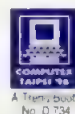


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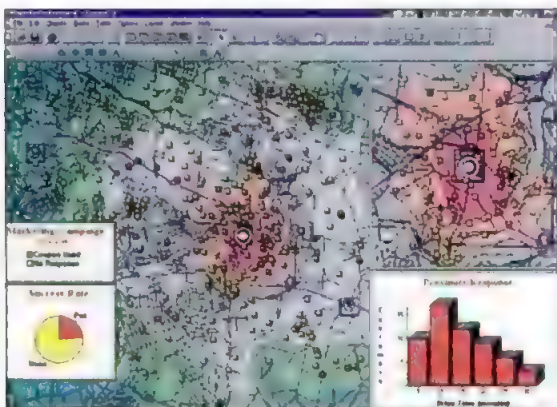


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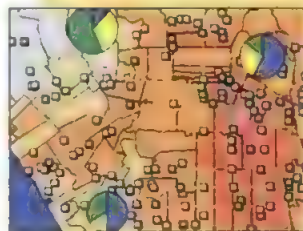
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Ctrl. I also used the Class Wizard to create my own handlers for the messages

```
LVN_BEGINDRAG  
WM_LBUTTONDOWN  
WM_RBUTTONDOWN  
WM_LBUTTONUP  
WM_MOUSEMOVE
```

Thus, drag-and-drop is handled by the control itself, not the main dialog. When the user moves an item in the list, the list control posts a private `WM_MY_ITEM_MOVED` message to the main dialog so it knows that it has to rebuild the list of new names.

To allow users to sort the list, I added a handler to the `CRenDlg` class for the `LVN_COLUMNCLICK` notification message. The list control posts this message to its parent window when the user clicks a button at the top of the column. The `CRenDlg::OnColumnClick` handler first determines which column the user wants sorted, sets some flags accordingly, and then calls the list control's `SortListItems` member function to perform the actual sort. `SortListItems` takes two parameters. The first is a pointer to a callback function used to compare two list items. The second parameter contains any user-defined

data that will be passed along to the sort function. The list control actually sorts itself, but it relies on the specified callback function whenever it needs to compare two list items to determine their relative sort order.

Since `CRenDlg::Compare_List_Items` is used as a callback function, it must be declared as a static function. When a member function is declared as static, that function does not receive the implicit `this` pointer that is passed to nonstatic member functions. As a result, `Compare_List_Items` cannot access any of the `CRenDlg` object's member variables directly, because it does not know which instance of a `CRenDlg` object is calling it. To solve this problem, I used the second parameter of the `SortListItems` function to pass the current `CRenDlg` object's `this` pointer to `Compare_List_Items`, enabling it to access the dialog's data.

PROCESSING TEMPLATES

When designing `MultiRen`, I wanted to give the user a way to specify new names that was both flexible and powerful, yet not overly complicated. I decided to use wildcards, like the DOS `ren` command, but with a few additions. I kept the traditional meanings for the wildcard characters `?` and `*` and used the

backslash character to signal the beginning of a command sequence.

To make parsing the templates easier, I began by limiting the user's input to characters that would be allowed in filenames and

SAMPLE TEMPLATE STRINGS		
Base-name template	Extension template	New name
*\n	*	FOOBAR24.DAT
\n*	??X	240BAR.DAX
\n*	.Txt	24-FOOBAR.Txt
\???\n*???	*	foo24r.dat
\???\n*_?_	\???\a file	Fbar_24 data file

FIGURE 3: The template examples shown here assume an original filename of `Foobar.dat` and two-digit sequence numbers starting with 24.

my custom commands. To do this, I used the MFC Class Wizard to create the `CFNEdit` class, derived from the `CEdit` class normally associated with an edit control. I needed to filter two possible sources of input: characters typed at the keyboard and text pasted from the clipboard.

To handle keyboard input, I overrode the control's `WM_CHAR` message handler. My `CFNEdit::OnChar` handler's first task is to ensure that the character typed is valid for use in a

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filename. I also provided special processing for the asterisk character. Since I use the asterisk to represent all remaining characters in the original name, there's never any need for more than one asterisk in a template. The remaining logic in `OnChar` rejects a typed asterisk only if there is an asterisk already in the field that lies outside the currently selected text.

To handle text pasted in from the clipboard, I overrode the `WM_PASTE` message handler. Note that for some strange reason, the Class Wizard does not recognize the `WM_PASTE` message, so I had to write the function declaration and its message-map entry myself. If you do this in your own code, be sure to place your function declaration and message-map entry outside the Class Wizard's reserved blocks in your header and source files; otherwise you may have problems using the Class Wizard later.

Unlike some message-handler overrides that you create with the Class Wizard, you do *not* want to call the parent-class `OnPaste` function from your override. The `CEdit::OnPaste` handler simply posts a `WM_PASTE` message to the control, which causes your `OnPaste` handler to be called again. Therefore, if you do call `CEdit::OnPaste` from within your override, your program will get stuck in an endless loop and finally crash with a stack overflow. To put this another way, it is entirely up to you to provide the functionality for the `WM_PASTE` command. You cannot simply alter some of the data and rely on the parent-class function to do the rest of the work for you.

The `OnPaste` handler begins by verifying that the clipboard can be accessed and contains data in `CF_TEXT` format. If so, it retrieves the text from the clipboard, scans the text for illegal characters, and replaces any it finds with `$` signs. Next, it calls the `ReplaceSel` member function to replace the user's current selection with the modified text from the clipboard. Finally, it retrieves the entire text string that resulted from the paste operation and removes any asterisks after the first one.

Since the edit controls ensure that the user's

templates will contain only valid filename and command characters, the `CFNEdit::ParseWildcard` function's task is greatly simplified. All it has to do is scan through the template and build a new name from that information. Note that my modified edit controls do not attempt to verify the syntax of any `\` commands. This would make the response sluggish as well as making editing more difficult than necessary. Instead, it's up to `ParseWildcard` to determine whether or not a template's syntax is valid and, if not, return an appropriate error code.

KEYBOARD SUPPORT

The last little detail I wanted to add to the program was the ability to move items in the list using the keyboard. To do this, I used the Resource Editor to create an accelerator table containing two entries—one for `ID_MOVE_UP` and one for `ID_MOVE_DOWN`—associated with the `Ctrl-<Up Arrow>` and `Ctrl-<Down Arrow>` keystrokes, respectively. However, getting the dialog to recognize those accelerators took a little extra work. Accelerator tables are normally associated with menus, but `MultiRen`'s dialog doesn't have a menu. Therefore, I had to connect the accelerator table to the dialog myself.

To put the accelerator table to work, I began by selecting the accelerator table in Developer Studio's resource window, then activated the Class Wizard. The Class Wizard recognized that the table was a new resource and asked me with which class the table should be associated. I selected `CRenDlg` from the list given, and the Class Wizard came up and allowed me to create handlers for the `ID_MOVE_UP` and `ID_MOVE_DOWN` command identifiers in the table.

With the command handlers created, I now had to make the connection between the accelerator table and the dialog. The first step of such a process is in the `CRenDlg::InitDialog` function. `CRenDlg::InitDialog` calls the `LoadAccelerators` API function to load the accelerator table into memory. `LoadAccelerators` returns a handle to the table, which it stores in

the `m_hAccelTable` member variable for later use. Note that since the accelerator table has been loaded from the DLL's resources, Windows will take care of releasing the table when the DLL is unloaded.

The next step takes place in the `CRenDlg::PreTranslateMessage` override. This function is called each time your window receives a message but before that message has been dispatched to your application. This allows you to alter the message before it is passed on to the normal message-routing mechanism or even discard the message entirely.

The `PreTranslateMessage` override checks to see if the message is a keyboard message. If so, it calls the `TranslateAccelerator` function. This compares the keyboard message with the key combinations in the accelerator table. If it finds a match, it converts the message to the appropriate `WM_COMMAND` or `WM_SYSCOMMAND` message, passes the message to the application, and then returns a nonzero value. Note that if it was able to translate the message, `TranslateAccelerator` does not return until the translated message has been processed.

If `TranslateAccelerator` returns 0, this means that the keyboard message has not matched any accelerators and has not been altered, so the override passes the message on to the parent-class `CDialog::PreTranslateMessage` handler for normal processing. If the return value is not 0, it means that the message has been translated and processed, so the function returns without calling the parent-class handler.

`MultiRen` is a simple but powerful program that demonstrates some useful Windows programming tricks. The next time you need to rename multiple files, don't sigh as you drop to a DOS prompt. Right-click on the files in Explorer and launch `MultiRen`. **PC**

Gregory A. Wolking, the author of MultiRen, is the primary sysop of the ZNT:Tips Forum on ZDNet/CompuServe and the PC Magazine Utilities discussion area on the Web. Sheryl Canter is the editor of the Utilities column and a contributing editor of PC Magazine.



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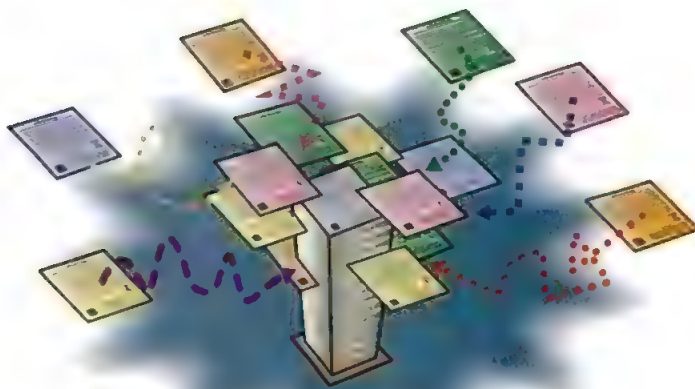
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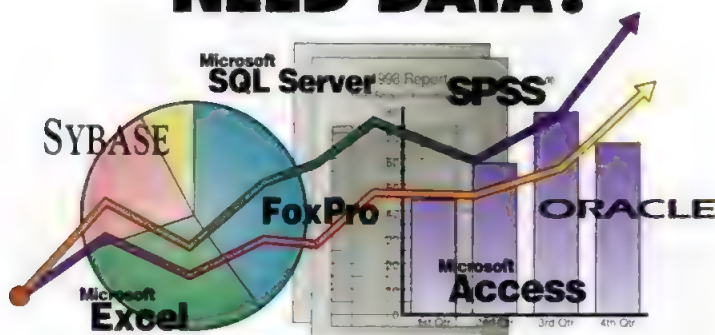
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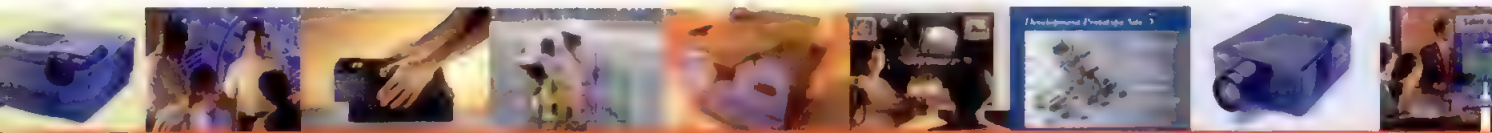


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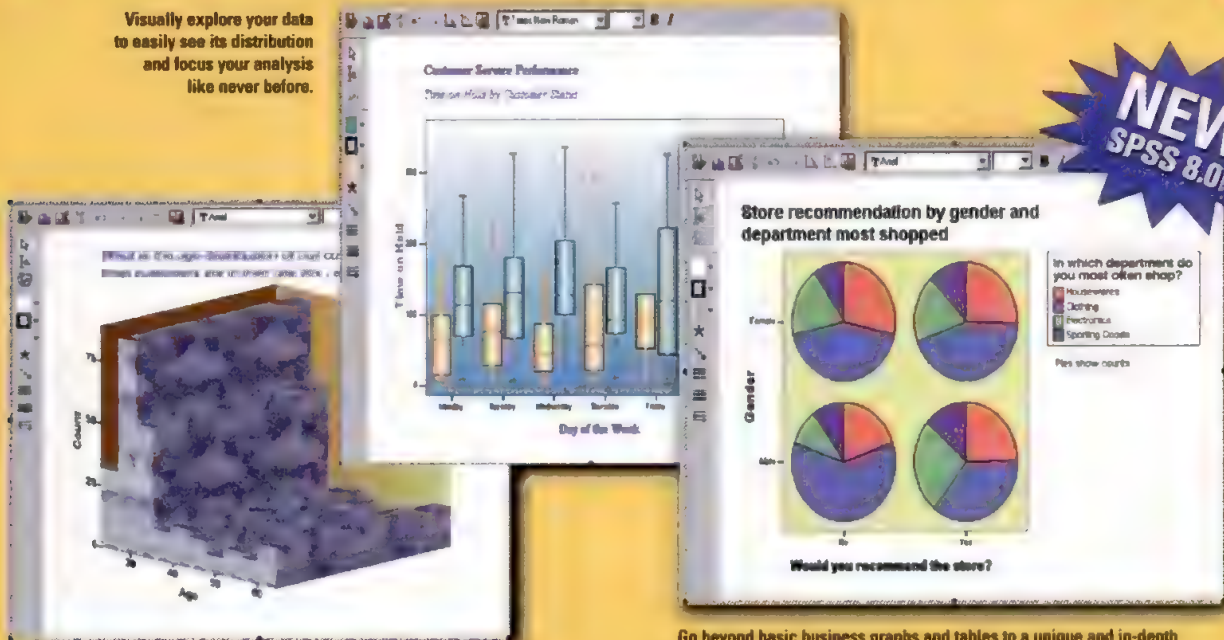
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User-to-User

BY NEIL J. RUBENKING

Putting the Date in a Windows NT 4 Batch File

You have published batch files that put the current month, day, and year into environment variables under Windows 95's DOS 7 as well as earlier versions of DOS. After several days spent trying to get these batch files to work under Windows NT 4, I went back to the command line for another look at the `for` command, which, as you can see from the batch file in Figure 1, is the key to making this work.

Note that if you use a date separator other than `/`, you'll need to change the `delims=` part of the `for` line to reflect the separator you use. Also, if your date format is not `MM/DD/YYYY`, you'll need to change the environment variable assignments as well. And of course, Windows NT's command extensions must be enabled.

CHARLES WILT
Dayton, Ohio

PC MAGAZINE: Way back in 1995, the original `Mmdd.bat` took advantage of an undocumented quirk in DOS's `for` command to split the current date into its individual characters and reassemble them into month, day, and year. DOS 7, however, eliminated this undocumented feature.

In the Solutions column of January 7, 1997, we published `Mmdd95.bat`, for use with DOS 7. This version treated the date string as a set of options for the `choice` command and redirected `choice`'s output, again for the purpose of splitting the date into individual characters. As this reader notes, neither version works under Windows NT 4's command processor.

The solution shown in Figure 1 relies on extensions to the `date` and `for` commands. The `date` command's added functionality is simple: The `/t` switch causes it to output the date without prompting for a new date. The extensions to the `for` command, on the other hand, are massive. Entering `for /?` at a Windows NT 4 command prompt yields well over 100 lines of explanatory text! Among the new command line switches are:

`/d`—matches wildcards against directories rather than files;
`/r`—executes recursively in the specified directory and all directories below it;
`/l`—generates a list of numbers in a specified range;
`/f`—processes each line in a text file, or one specific text string, or another program's output.

The `for` command's variable now can include modifiers as well (though `Ntmmdd.bat`

does not use them). For a variable named `%i`, these modifiers can be used, alone or in combination:

`%f`—fully qualified pathname;
`%d`—drive letter;
`%p`—path;
`%n`—filename;
`%x`—file extension;
`%s`—short names only;
`%$PATH`—return the first matching file found on the path.

For a thorough explanation of all the new switches, open a Windows NT 4 command prompt window, type `for /? > forcmd.txt`, and then carefully study the file `Forcmd.txt`.

Now let's pick apart the `for` command at the heart of `Ntmmdd.bat`:

```
for /F "delims=/ tokens=1-4" %i in
('date /t') do %0 %i %j %k %l
```

The `/f` switch means that `for` will do one of three things, depending on the status of the filename set in parentheses.

- If the filename set is a string with no quotation marks, it represents a filename, and `for` will process each line in that file.
- If the filename set is a text string contained in double quotation marks, `for` will process the text string.
- If the filename set is a text string contained in single quotation marks, it represents a com-

mand whose output will be processed by `for`. In this case, the output of the command `date /t` is processed.

The `delims=` option string indicates that each input line should be divided into tokens, using forward slashes or spaces as delimiters. That is, the portion of the string up to the first space or slash becomes the first token, the portion between that delimiter and the next becomes the second token, and so on. The `tokens=1-4` option string says that the `for` command should assign the first through fourth tokens to variables. In the action portion of the command (the part following `do`), the first token is represented by the `for` variable `%i`, and the rest use the successive characters `%j`, `%k`, and `%l`. Thus this line splits the output of the `date /t` command (for example, `Wed 01/21/1998`) into four separate elements: `Wed`, `01`, `21`, and `1998`. It then executes the batch file again, passing those four elements as command line arguments.

When the batch file is executed again, it stores the day of the week, day, month, and year in environment variables and also displays them. If you need to write a batch file that uses these variables, simply include a `call` to `Ntmmdd.bat`. You'll probably want to comment out the three `echo` lines at the end.

You can obtain all of the files mentioned in this article from our Web site. Point your browser to www.pcmag.com/download and choose *Issue Archives*. Then download the file named `V17n11.zip`.

```
@ECHO OFF
REM Assumes MM-DD-YYYY format.
REM Assumes date separator is "/".
IF NOT '%1'==' ' GOTO SetEnvVars
for /F "delims=/ tokens=1-4" %i in ('date /t') do MMDONT.BAT %i %j %k
%l
GOTO Done

:SetEnvVars
set DayOfWeek=%1
set Month=%2
set Day=%3
set Year=%4
set Date=%1 %2/%3/%4
ECHO Date is %Date%
ECHO Day of Week is "%DayOfWeek%". Month is "%Month%"
ECHO Day is "%Day%". Year is "%Year%"

:Done
```

FIGURE 1: This Windows NT 4 batch file puts the current day of the week, day, month, and year into environment variables.



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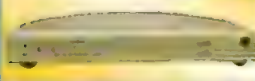
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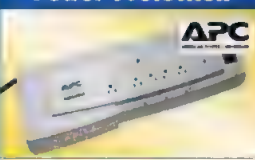
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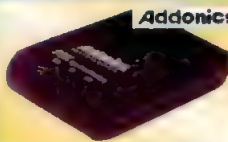


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HARDWARE

Hard Disk Hang-Up

I have four IDE devices already installed in my desktop system, and I am thinking about adding a CD-RW drive. Is there a way that I can add one more IDE device, or do I have to go to SCSI at this point?

CHRIS ELLISON
via the Internet

PC MAGAZINE: In general, you are limited to just four IDE devices in a system. You can have only one master and one slave device on a channel, and you can only have a primary and a secondary channel.

Some devices can add a third channel, however, making it possible to add one or two more devices. For example, Promise Technology (San Jose, CA; 800-888-0245, 408-452-0948; www.promise.com) has an Ultra33 card that will coexist with the existing IDE channels in your computer. GSI (Irvine, CA; 800-486-7800, 714-261-7949; www.gsi-inc.com) makes an IDE adapter that handles up to eight devices (using four channels).

If you already have the money invested in IDE devices, adding a third IDE channel may make the most sense. If you are just starting to configure your system, however, it may make more sense to plan on using a SCSI bus. A SCSI adapter can handle at least 7 devices (some can handle up to 15) and has the added benefit of being able to work with nonstorage devices such as scanners.—*Alfred Poor*

OPERATING ENVIRONMENTS

Changing the Icon For a Folder

Recently I put a folder on my Windows 95 desktop and then dragged some icons for games into it. Everything works fine, but the folder just doesn't look good next to all the icons. Can I change that plain folder on my desktop to an icon?

ALAN SMITH
via the Internet

PC MAGAZINE: You can't change the icon for an individual folder, but you can still get the result you want. By creating your games folder on the desktop, you've actually created it within the desktop folder, which resides in your Windows 95 folder. Use Explorer to locate the games folder and convince yourself

this is true. What you need to do is to take the games folder out of the desktop folder and leave a shortcut to the folder instead. Windows 95 lets you take control of which icon is used to represent a shortcut.

Right-click the games folder and select *Create Shortcut* from the menu; the shortcut will appear on the desktop. Now, in Explorer, drag the games folder from the desktop folder into another folder; perhaps put it right in the Windows 95 folder. The folder icon will disappear from the desktop when you do this, but the shortcut will remain connected.

Right-click the shortcut, select *Properties* from the menu, and click the *Shortcut* tab. Press the *Change Icon* button and select the icon you prefer. Press *OK*. Now to clean things up, click the caption under the shortcut (which will be something like "Shortcut to Games") and then click it again after a second. You can now edit the shortcut's title to just Games.

That's it! When you open the shortcut, the folder opens. When you drag something onto the shortcut, Win 95 knows you want to drag it into the folder the shortcut points to. You basically have everything the same as before, except that you can now control the icon that represents your folder on the desktop.

—*Neil J. Rubenking*

WORD PROCESSING

Stepping Through WordPerfect Macros

Anyone who writes any kind of computer program will run into situations where a program doesn't work as expected—especially on early tests. This is just as true for WordPerfect macros as for any other kind of programming. I'm using WordPerfect for Windows 6.1 and would like a way to step through my macros, one command at a time, as an aid to spotting where problems show up. I have not been able to find any way to do this, but it's such a basic tool that I wonder if I'm just missing something. Is there a way to do this, or did WordPerfect forget to add the obvious?

MATTHEW FISH
via the Internet

PC MAGAZINE: WordPerfect does, in fact, have a *Step* command. As best as I can tell, however, this crucial macro-debugging tool isn't documented in WordPerfect 6.1 at all. And while it's documented in WordPerfect 7

and 8, the information is minimal at best and hard to find.

To use the *Step* command, you only need to add the following two lines at the beginning of any given macro:

```
Display(On!)
Step(On!)
```

The first line tells WordPerfect to show you each step on-screen as the macro runs. Without the line, you won't see the effect of each command as it happens. The second line brings up the WordPerfect Macro Interpreter in Version 6 or the somewhat more sophisticated PerfectScript Debugger in Version 7 or 8, to let you control the macro.

The WordPerfect 6 Macro Interpreter lacks a help system, but it's straightforward enough. You'll find check-box options to display variables, as well as buttons to run, abort, and step through the macro. The WordPerfect 7 and 8 Debugger offers more options. For details on how to use it, choose *Help* on the *Debugger* menu after the macro calls it up, and browse through the information. You'll find several variations for stepping through the macro on the *Debugger* menu as well as

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the toolbar. You'll also find function-key shortcuts listed on the *Debugger* menu.

In all three versions of the program, you'll probably want to open a macro-editing window before you run the macro to step through it. The Interpreter in Version 6 and Debugger in Version 7 and 8 refer only to line numbers as you step through the macro; opening the macro itself will let you see the commands.

Finally, in all three versions, once you're satisfied the macro works, you can delete the *Display* and *Step* lines, or you can leave them for possible future use and add *//* at the beginning of each to tell WordPerfect to ignore them.—*M. David Stone*

SPREADSHEETS

Non-Western Number Formats

In India we use the following units (as against millions and billions) for currency as well as for other large numbers: a lakh, which equals 100,000 and is written as 1,00,000, and a crore, which equals 100 lakhs (or 10,000,000) and is written as 1,00,00,000.

I would like to create formats in both Excel 95 and Excel 97 to represent lakhs and crores. For example, "rupees 1 lakh, 15 thousand, 35" (115,035 rupees) would be written as Rs. 1,15,035. The figure for a population of 900 million would be written as 90 crores or 90,00,00,000. The important thing is to get the commas in the right places. Can you help?

RAJAN DEVAYANI
via the Internet

PC MAGAZINE: In any version of Excel, you can create a custom format to handle the non-standard comma separators required for lakhs and crores. For lakhs, the custom format code should look like this:

```
##".###".###
```

For crores, it should be:

```
##".###".###".###
```

To create one of these formats, select the cells you want to format, choose *Cells* from the *Format* menu, click the *Number* tab, choose *Custom* in the *Category* list, and type the format code on the *Type* line. Note that you must enclose the commas within double quotation marks. If you leave out the quotation marks, Excel will interpret the commas as normal thousands separators, and even though you will have clearly positioned them at two-digit intervals, it will correct your "mistake" for you.

Fortunately, Excel can include any number of literal-text characters within numeric formats. Dropping text into the format does not convert the number to text. The number remains a number and can be used in calculations no matter how much text is embedded in it. (Thus, for example, you can create custom formats that put hyphens into Social Security numbers, or parentheses around area codes, and still have those numbers available for calculations—should you have any need to do that.)

Literal-text commas are exactly what we need to make lakh and crore values appear the way they should. To change the commas from ordinary separators to literal text, we simply enclose them within quotation marks.

In a format with literal text, however, Excel displays the text no matter what the size of the number. That's why separate formats for crores and lakhs are needed. If you applied the crores format to a number such as 115,035, Excel would display "1,15,035."

Once you've created these custom formats, you can simplify their application by recording two macros and assigning a keyboard shortcut to each. Choose *Macro* and then *Record New Macro* from the *Tools* menu. In the *Record Macro* dialog box, type the keyboard shortcut you want to use and click *OK*. Back on the worksheet, apply your format, and then click the *Stop Recording* tool (or choose *Tools | Macros | Stop Recording*).

Now, whenever you want to use one of these formats, you can simply select the cells you want to format and type the appropriate keyboard shortcut.

If you want all large numbers on a worksheet or in a workbook to have one of these custom formats, you can create an event-driven macro that will apply the format auto-

matically. In Excel 97, press Alt-F11 to invoke the Visual Basic Editor. Then double-click *Sheet1* in the Project Explorer (if the Project Explorer isn't visible, press Ctrl-R). In the two drop-down lists at the top of the code window, choose *Worksheet* on the left and *Change* on the right. You'll see a procedure template in the code window that looks like this:

```
Private Sub Worksheet_Change(ByVal  
Target As Excel.Range)
```

```
End Sub
```

Between those two lines, type:

```
LakhsCrores Target
```

Repeat this process for any other worksheets to which you want the formats automatically applied. Now, choose *Module* from the Visual Basic Editor's *Insert* menu. In the new module that appears, type the code in Figure 1. Note that you need to double the quotation marks around the commas, because the format codes are themselves text strings.

That's it. Each time your worksheet changes, Visual Basic runs the *LakhsCrores* macro on the range that has changed. If the value of the changed range falls into the lakhs or crores range (positive or negative), the appropriate custom format is applied. If the range contains a number that does not fall into either range, nothing is done. (Dates are numbers in Excel, but they lie outside the lakhs and crores ranges, so this macro does not affect them.) If the changed range contains text or an error value, the *Select Case* structure generates a type mismatch error, but the *On Error Resume Next* statement at the top of the macro causes Visual Basic to ignore the error.

```
Sub LakhsCrores(ThisRange As Range)  
On Error Resume Next  
For Each c In ThisRange  
Select Case c.Value  
Case Is <= -10000000 'negative crores  
c.NumberFormat = "##".###".###".###"  
Case -10000000 To -100000 'negative lakhs  
c.NumberFormat = "##".###".###"  
Case Is >= 10000000 'positive crores  
c.NumberFormat = "##".###".###".###"  
Case 100000 To 10000000 'positive lakhs  
c.NumberFormat = "##".###".###"  
End Select  
Next c  
End Sub
```

FIGURE 1: This Excel 97 code applies Indian number formats.

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```
Private Sub Report_Open(Cancel As Integer)

' Use MsgBox to ask whether to include last year's donations.
Dim intChoice As Integer
intChoice = MsgBox("Include last year's donations in the report?", _
vbYesNoCancel, "Report: " & Me.Name)

' If the user chooses Cancel then cancel the report.
If intChoice = vbCancel Then
    Cancel = True
    Exit Sub
End If

' Set the visible properties according to the choice.
If intChoice = vbYes Then
    Me.LastYearDonations.Visible = True
    Me.LastYearDonationsLabel.Visible = True
Else
    Me.LastYearDonations.Visible = False
    Me.LastYearDonationsLabel.Visible = False
End If

End Sub
```



FIGURE 2: The code shown here can be placed in the report's On Open event to ask the user whether to include last year's donations in the report. The code changes the Visible properties of the fields involved, depending on the user's choice.

Incidentally, the *Conditional Formatting* command in Excel 97 is not useful in this situation; it can assign fonts, borders, or patterns, but not numeric formats.

In Excel 95 or Excel 5, you need to follow a slightly different procedure. We've made a macro available on PC Magazine Online that does the job. Choose *Module* from the *Insert* menu, go to the new module, and type the code.

The *auto_open* macro, which will run automatically the next time you open the worksheet, sets up an *OnEntry* event trigger, causing the *LakhsCrores* macro to run whenever anything on the worksheet is changed. *Application.Caller*, which is assigned to the *Range* object *MyRange* in the *LakhsCrores* macro, is the cell or range that triggers the *OnEntry* event. The macros are downloadable from PC Magazine Online.—*Craig Stinson*

DATABASES

Yes/No Prompts for Reports

How do I build a macro that asks the user whether he wants a column of numbers to appear on a report? I've built an Access database for a private school that conducts annual financial campaigns. One of the reports is a list of potential donors and their previous year's donations. The school would like to provide this list, but without the donations, to telephone callers for use in making contacts with donors.

By changing the Visible property of the field involved, I can easily print the report without the information, but I would like to give the user the choice. Can you help?

DAVID DE KOEKKOEK
Ontario, California

PC MAGAZINE: Probably the simplest technique would be to save two copies of the report, one with the column visible and one without. But that would create twice as much maintenance work if you ever needed to change the report design. You could stick to a single report with some code attached to the *On Open* event. The code would ask whether to include the field in the report and set the field's *Visible* property depending on the user's preference. Figure 2 shows an example.

The code uses the *MsgBox* function to display a dialog asking the user whether to include last year's donations. The *vbYesNoCancel* constant shown in the second argument tells Access to include *Yes*, *No*, and *Cancel* buttons in the dialog. The value returned by *MsgBox* corresponds to one of the three VBA constants *vbYes*, *vbNo*, or *vbCancel*, depending on which button the user clicks. Pressing *Esc* is the same as clicking *Cancel*.

You'll notice that *Report_Open* is passed a single argument called *Cancel*. Access provides this so that you can set *Cancel* to *True*

within the function if circumstances arise that require canceling the report. When the function finishes, Access checks the value of *Cancel*, and if it is *True*, the report is canceled.

After the user makes a choice via the message box, the code checks to see whether the *Cancel* button was chosen. If so, the *Cancel* argument is set to *True* and the routine is exited. Next the code checks for a *Yes* or *No* response and then sets the *Visible* property on the *LastYearDonations* and *LastYearDonationsLabel* controls to either *True* or *False*. This assumes that *LastYearDonations* is a text box in the detail section and *LastYearDonationsLabel* is a label in a header. You'll have to replace these with your own text box and label names, of course.

That's all that's needed. To attach the code to the *On Open* event, open the report in design mode. Then choose *Select Report* from the *Edit* menu. Select the *View* menu and choose *Properties*. When the *Properties* box appears, select the *Event* tab and click in the *On Open* text box. When the *Build* button (an ellipsis) appears to the right of the text box, choose it. Then choose *Code Builder* and click *OK*. A code window will appear, with the procedure heading and final *End Sub* statement filled in for you. Type your event handler between them. When you're finished, repeatedly select *Close* from the *File* menu until you've saved the modified report.

Bear in mind that you can modify other report properties from within the *Report_Open* procedure. For instance, if the user decides not to include a column, you might then want to change the *Left* property of the columns on the right of the omitted column, to slide them over and fill the empty space.

—*Sal Ricciardi*

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2100W, 5133/5168 1200W 2000W/C, MS-T 5100/5133 1200W					
2100W, 5168 1200W 2100C (EDO)					
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Model 4300C, MS6300 Model 4300 c/NT, MS6333 Model 6400C/NT,
Bravo EL 6233 Model 3200 w/95, Model 4300C/95, 6266 Model 32
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64MB	\$237.38	92630			

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7330T, 7350MT, 7360DMT, 7370DMT, 7380DMT, 7710MT, 7730MT,
7750MT, 7770DMT, 7790DMT, 7792DMT, Presario 1710 SB (EDO)

16MB	\$56.87	88052	32MB	\$119.78	88053
64MB	\$319.43	96829			
Armada 4110, 4110D, 4125D, 4126, 4120T, 4130T, 4131T, 4150, 4180T, 4210T, 4220T					
8MB	\$53.39	74915	16MB	\$92.00	74917
32MB	\$147.68	74918			

Desktop 6000 6233, 6266, 6300

SDRAM			32MB	\$97.55	90166
16MB	\$42.12	90165			
ECC SDRAM			32MB	\$139.84	99210
16MB	\$119.00	99548			
64MB	\$289.54	99587			

Desktop 4000 5200, 5233, 5168

16MB	\$42.12	90165	32MB	\$97.55	90166
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Desktop 2000, 4000, 6000, Presario 2200, 3060, 4160

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32MB	\$108.93	74167	64MB	\$196.95	74168

Desktop 2000 5168MMX, 5200MMX, 5233MMX, 5000 5168MMX,
5200MMX, 5233MMX, 5000 6233X/2100CDS, 6266X/2100CDS,
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1681

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64MB	\$254.38	95142			

Presario 902, 9536, 9546, 9548, 972, 982, 974, 992,

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32MB	\$108.19	54682	64MB	\$149.29	54681

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4860, 4860 4805, 4805, 4828

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64MB	\$248.13	93936	128MB	\$357.40	93937

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8MB	\$53.36	98839	16MB	\$47.45	98840
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DELL

Dimension XPS D333

ECC SDRAM			32MB	\$139.84	98210
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64MB	\$226.96	99587			

Optiplex GX w/MMX, Optiplex N NetPC w/MMX (EDO memory)

16MB	\$47.45	98840	32MB	\$92.09	98841
64MB	\$196.96	98842	128MB	\$367.57	98843

Latitude CP M1685T, M233XT, M2335T (EDO memory)

16MB	\$71.87	104307	32MB	\$129.57	104308
64MB	\$238.00	104309	128MB	\$448.32	102582

Latitude CP M1335T

16MB	\$84.00	98884	32MB	\$119.00	98886
64MB	\$229.56	98888			

Dimension XPS D233, 266, 300, Optiplex GXn

SDRAM			32MB	\$97.55	90166
16MB	\$42.12	90165			
ECC SDRAM			32MB	\$139.84	99210
16MB	\$119.00	99548			
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FUJITSU

LifeBook 565TX, 635TX, 666TX, 675TX, 735Dx, 755TX, 765TX,
985TX

16MB	\$78.15	97302	32MB	\$129.00	97304
64MB	\$254.38	97306			

LifeBook 4200, 430DX, 5200, 520T, 530T, 531T, 535T, 556T,
557TX, 630T, 666TX (EDO memory)

8MB	\$36.51	83130	16MB	\$96.86	80765
32MB	\$119.79	80426			

HITACHI

VisionBook Elite 8560, 8565, Traveler, Pro 7340, 7360, 7860,
7860, Plus 4140, 4360, 4360 (EDO memory)

8MB	\$36.51	94821	16MB	\$96.86	94822
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Pavilion 7270, 7275S, 7280P, 7285, 7295V, 7320, 7330Z, 7350P,
7360, 7370V, 8140, 8190 (EDO Memory)

8MB	\$37.21	62900	16MB	\$47.75	62797
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Vectra VE4, VL7, Brio 8316, 8317, 8336, 8337, 8338, 8276, 8377,
8379, Kayak XA, XU, Pavilion 3100 w/MMX, 8190, 8280, 8240,
8275, 8276, 8280, 3290

16MB	\$47.75	98840	32MB	\$92.09	98841
64MB	\$196.96	98842	128MB	\$367.57	98843

Brio 8012, 8014, 8017, 8032, 8034

8MB	\$37.21	62800	16MB	\$47.75	62797
32MB	\$109.93	62798	64MB	\$196.96	62799

LaserJet 4000, 41, TN, 5000, 5000M, 5000GN

EDO			32MB	\$148.39	100398
16MB	\$83.85	100397			
SDRAM			32MB	\$108.53	100402
16MB	\$51.96	100401			

LaserJet 6P, 6PSE, 6MP, 6PKI

4MB	\$16.85	45306	8MB	\$28.08	42443
16MB	\$47.04	45308			

LaserJet 6LXI, 6LSE, 6L, 6L, 6L, 6L Extra

4MB	\$41.43	60869	8MB	\$51.96	80570
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ThinkPad 770

EDO			32MB	\$119.00	71913
16MB	\$51.79	69704	128MB	\$789.05	107972
64MB	\$247.83	105393			
SDRAM			32MB	\$129.69	97304
16MB	\$78.15	97302			
64MB	\$254.38	97306			

ThinkPad 310ED, 365 X Series, 365X, 365XD, 380, 390D,
380ED, 380XD, 385D, 385XD, 580, 580E, 580X, 780, E, ED, EL,
ELD, XD, XL, 786D, L, LD (EDO memory)

8MB	\$36.51	69680	16MB	\$61.79	69704
32MB	\$119.00	71913	64MB	\$179.06	108652

Active C22, C33, C55, C85, C86, C87, C8Y, C73, C77, 584, 586,
574, 578, 57H, 580, 580 (EDO memory)

8MB	\$35.11	74840	16MB	\$29.39	72593
32MB	\$108.84	72594	64MB	\$194.35	77193

Active E14, E16, E24, E26, E34, E46 (EDO memory)

16MB	\$119.79	107968	32MB	\$160.81	107969
64MB	\$229.18	107970	128MB	\$707.42	107971

Active S35, S3C, S8C, S9C, S3H, C3D, C3E, C8E, C8F, C8H,
C9E, C9F, C9E, C85 (SDRAM)

8MB	\$69.86	90621	16MB	\$89.30	90623
32MB	\$119.79	90616			

Active S84, S86, S74, S78, S7H, S80, S80 (EDO memory)

64MB	\$194.35	77193			
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PC-300GL, 628230U, 628232U, 628234U, 628238U

8MB	\$72.56	90286	16MB	\$51.25	90287
32MB	\$109.53	90288	64MB	\$237.39	90873

PC-300XL, 658810U, 12U, 15U, 41U, 51U, 61U, PC-300PL, 6582
series

16MB	\$71.87	90871	32MB	\$129.87	90872
64MB	\$237.39	90873			

PC 300 Model 330 6577-all, Model 350 6587-all, PC 700 model
730, 750 A, E, N, B, F, P

8MB	\$35.11	74840	16MB	\$59.39	72593
32MB	\$108.84	72594			

NEC

Ready 7622, 7624, 9620, 9621, 9622, 9624, 9625, 9626, 9627,
9628, 9629, 9701, 9702, 9710, 9712, 9714, 9716, 9722, 9723, 9732,
9733, 9734, 9734A, 9735, 9736, 9738, 9740, 9743, 9745A, 9620

8MB	\$29.19	68607	16MB	\$55.47	68604
32MB	\$105.35	68605			

Ready 8753, 8759

16MB	\$119.29	111901	32MB	\$167.18	111903
64MB	\$275.70	111904			

TOSHIBA

Libretto 50CT, 70CT (BST)

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T710CDT, 720CDT, 730CDT, 730CDT, 730CDT, 730CDT, 730CDT,
Satellite 110, 115, 200CDS, Satellite Pro 420, 430CDT, 430CDS

8MB	\$69.07	67892	16MB	\$96.57	67893
32MB	\$168.59	67894			

Satellite 300CDS, 300CDT, 305CDS, 310CDS, 310CDT, 315CDS,
315CDT, Tecra 730CDT

16MB	\$68.80	109496	32MB	\$129.24	109497
64MB	\$245.21	110309			

Tecra 220CDS, 460CDT, 470CDT, 480, 500, 510, 520CDT, 530CDT,
550, Satellite Pro 440CDT, CDX, 460CDT, (EDO memory)

8MB	\$45.84	72535	16MB	\$68.80	72534
32MB	\$129.16	74685	64MB	\$248.21	82011

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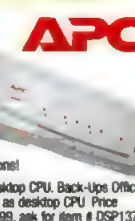
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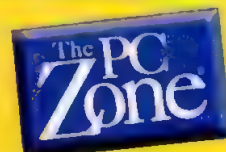


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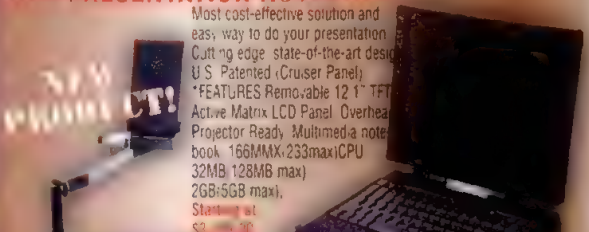
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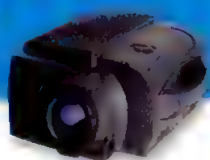
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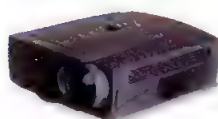
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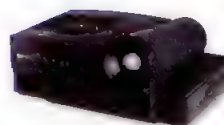


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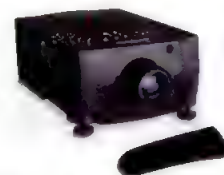
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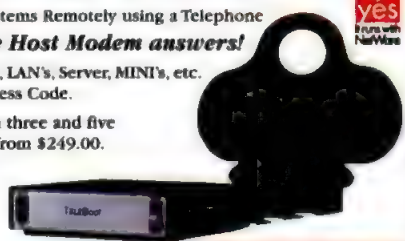
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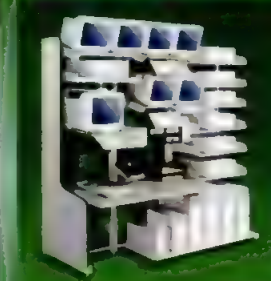


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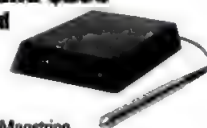
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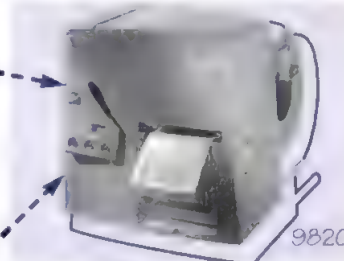


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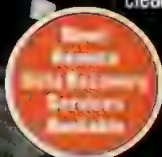
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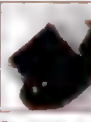
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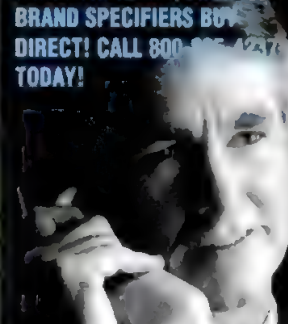
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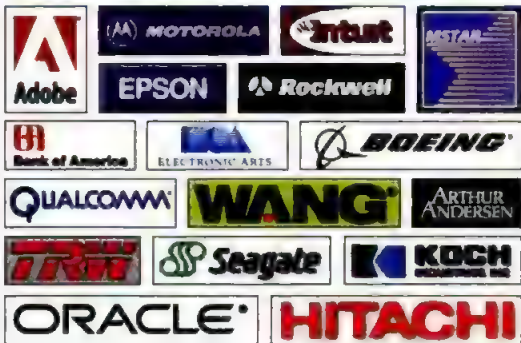
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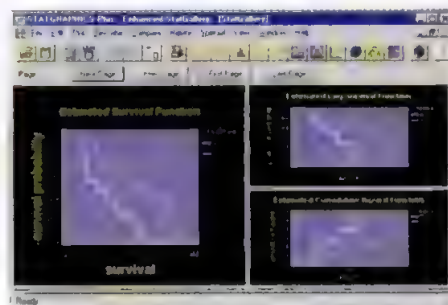
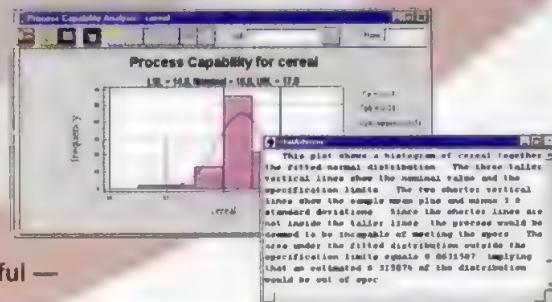
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After Hours

Child's Play

Five new games to tickle a young child's fancy—and stimulate a growing mind.

By Karen J. Bannan

Cruising store isles jammed with the latest and greatest in kids' software can be overwhelming, especially if you're accompanied by a pre-teen who begs for everything in sight.

When you're buying games for the 8- to 14-year-old set, here are a few suggestions to keep in mind: Make sure that the program is heavy on interactivity (a story-book-type title can bore kids in this age group). Look for games that offer variable levels of difficulty so that the child won't outgrow the program too rapidly. And to increase the replay value, look for titles that offer more than one type of puzzle or activity.

The five programs we tested, though wildly disparate in subject matter, have one thing in common: They all hit the mark when it comes to appealing to kids.

Barbie Cool Looks Fashion Designer

Mattel Media struck a chord with girls nationwide when it brought America's favorite doll, Barbie, to the PC. Barbie Fashion Designer sold more than a mil-



lion copies and was among the first programs to meld the computer with traditional toys. The company's follow-up title, Barbie Cool Looks Fashion Designer, is sure to be equally successful.

Staying true to its vision, Mattel has kept the winning original formula. The CD-

ROM lets children design outfits that can be printed out on specially formulated paper-backed cloth. Barbie can actually wear these creations. In this newest version, kids can design clothes inspired by five themes: After-School Fun, On the Job, Pajama Party, Surf & Sun, and Team Spirit. After kids have made their way through the dozens of patterns and colors and assembled their "ultimate outfits," they can have Barbie or one of her four friends model the outfits on-screen, complete with accessories and shoes.

The program comes with eight pieces of Fashion Fabric



(paper-backed fabric that works with your printer); five pairs of shoes for Barbie; paint, sequins, and bows; and adhesive tape to put the designs together. Once they are printed, outfits are cut out, decorated, and assembled on the Barbie doll.

The new My-Size accessories feature lets kids make matching accessories, such as a change purse, for themselves. Also new is e-mail that allows kids to send their designs to friends so Barbies can wear matching outfits.

When we tested the program, we went through the paper that came with the CD-ROM in less than an hour, so be sure to buy a refill pack (\$15 street) if you have more than one child using the program. Parents may also want to stay with children the first time they print their designs, since feeding the paper through the printer can be tricky.



Carmen Sandiego Math Detective

The latest Carmen Sandiego title joins a long line of educational software from Broderbund Software. Carmen Sandiego Math Detective endeavors to teach children basic math, including fractions, word problems, and geometry.

Carmen, an international thief and member of the V.I.L.E. gang, is up to her old tricks. This time, she has shrunk

INSIDE

THE FULL MONTY

Members of the Monty Python troupe reveal the true meaning of life. Page 342.

YOUR OFFICIAL GUIDE

The "Babylon 5" CD-ROM goes behind the scenes of the TV show. Page 342.



DRAWING 101

Artist! provides instruction for aspiring artists and casual doodlers. Page 345.

After Hours

12 international landmarks, placed them in locked crystal capsules, and hidden them around the world. Kids become detectives and are asked to find the crystals, decode the clues that are needed to open them, and restore the items to their rightful locations.

Even though kids will have to perform hundreds of problems to crack the case, the heavy dose of mystery and intrigue helps them forget that they are playing an educational game. Facts and figures are disguised behind training simulators, video and e-mail transmissions, a transporter, and secret hideaways.

We liked the program's flexibility and depth. For example, when kids are having difficulty with a particular concept or problem type, parents and teachers can create their own custom lessons. And since there are three different skill levels, game play can advance with your child's knowledge.

One of our favorite activities, Atom Smasher, is reminiscent of "Beat the Clock." Here, kids are asked to solve ten problems in less than 3 minutes. Each correct answer is rewarded with another letter of a password, but incorrect answers subtract time from the clock.

Though the game is targeted at kids from 8 to 14 years old, those at the high end of this spectrum may find themselves turned off by the slightly juvenile theme. The young and young at heart, however, will enjoy the escape that the lessons provide.

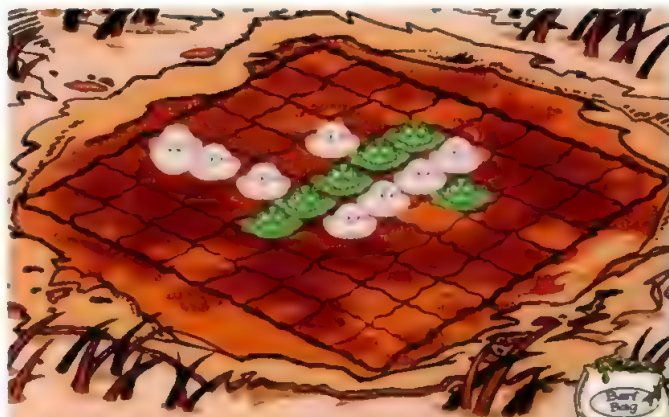
Grossology

What child can resist a good barf joke? If Grossology is any indication, not too many can. This hysterical title, based on the similarly named

book series by Sylvia Granzel, is designed to teach children about the human body. But there's a twist: Instead of studying the usual boring charts and diagrams, kids learn science and anatomy by focusing on the most vile—and to them, the most fascinating—bodily functions.

Designed for children aged 8 to 12, Grossology features nine labs that demystify all of the noises, smells, and excretions that kids already love to giggle over. Each lab explains in simple language how the body works and what function the particular "grossness" plays in a person's health. When kids have finished learning, they can play a game that drives the lesson home—and usually makes lots of loud, embarrassing noises emanate from your computer's speakers.

Lessons include topics such as Poop, Farts, and Diarrhea; Pee Pee; Scabs, Wounds, and Blisters; B.O., Sweat, and Smelly Feet; and Spit and Saliva. In addition to the labs and games, there are plenty of songs, tons of disgusting clip art, printable crossword puzzles, and the parental favorite: do-it-yourself experiments. One



WHITE CELLS: 8 BACTERIA: 6

GROSSOLOGY
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www.grossologygames.com



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lovely experiment involves mixing a few household ingredients to produce some very realistic-looking snot.

Our testers loved the Poo Poo Pinball Game, in which they could build up fart power by hitting flying vegetables, and the Tetris-like Zit Attack game, which teaches kids the benefits of keeping skin clean. Appealing? No. But fun? Yes.

Although parents may have to make an effort to love this game, kids will be instantly mesmerized. We especially liked the bright graphics, simple navigational menu, and rewards-based teaching meth-

odology. No buts about it, Grossology earns an enthusiastic five out of five burps in our book.

Hades Challenge

The follow-up title to Disney's wildly successful CD-ROM Hercules Animated StoryBook is sure to delight both young and old fans of the animated movie, but parents may find it light on educational value.

The premise is simple: Children take on the persona of Hercules and travel through Greece or down into the underworld to defeat the evil Hades. Along the way, they solve puzzles, collect weapons, and fight villains.

The CD-ROM features four sections, each based in a different location. As players explore Crete, Troy, Medusa Isle, and the Underworld, there are some opportunities to learn about customs and mythology. For example, kids can participate in the Trojan War, and inspired parents can use the opportunity to discuss the real Trojan War with their kids.

The program is packed with puzzles that are somewhat challenging but aren't exactly

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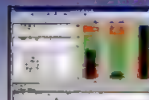
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After Hours

unique. Like many other children's titles, Hades Challenge has mazes to maneuver and riddles to solve, but much of the real action comes from watching the animations. We did enjoy the often-humorous quiz show, which focuses on mythology and reinforces the few educational elements of the disk.

Beyond its game play, the title's true strong point is its intense, lyrical animation, which has a depth and vibrant beauty rarely found in a children's game. We also liked the Save feature, which allowed us to leave the game without losing all of our experience and the progress we had made.

Hades Challenge is designed for children over 8 years old, because of its fast-paced action and a smattering of fighting and violence. Parents can rest assured, however, that their children won't see

anything worse than what's featured in many Saturday morning cartoons.

Hades Challenge is a visually appealing title with amusing games, but parents shouldn't look to this disk as a resource for exploring Greek mythology with their kids.

Zero Zero

Zero Zero isn't your average children's game, but once you get past its slightly surreal quality, you and the kids are in for a treat. The story is set in late-19th-century Paris. Our heroine, Pinkee LeBrun, an adorable chimney sweep, is pondering the future and setting the stage to teach us about the past.

Within the title, children will find 11 areas to explore, including a library, bakery, cinema, toy shop, and greenhouse. Children navigate through the title by clicking on the area they wish to visit; as



soon as they do, Pinkee pops down a chimney into which-ever location they chose. Each destination features plenty of clickable items and stories for the younger set, as well as puzzles and games for older kids. All of the written material is in French, as are many of the spoken words. But translations

accompany everything, so your child may end up learning some French.

Unlike most other children's games, this title cannot be categorized as either entertainment or educational fare. In fact, the word *edutainment* could almost have been created expressly to describe Zero Zero. Plenty of puzzles keep children occupied, but learning is definitely emphasized. Whether your kids are learning about philosophers, the French Revolution, or famous historical figures, you always know that the message is getting through the madness.

We loved the expansive range of stories, which run the gamut from silly to scary. For example, in "Le Drinkie," the barkeep tells a tale of enchanted stars that find their way into lemonade bottles to create a bubbly drink. Later, children can use the trapped bubbles to propel corks and fight a quick battle.

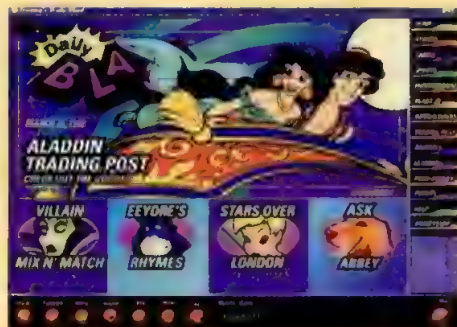
Although we enjoyed Zero Zero, very young children may be turned off by its dark, slightly spooky graphics. But the bouncy sound track and mystical story line are sure to delight most of the preteen set.

Disney's Blast

CD-ROMs aren't the only source of top-notch educational and entertaining content for kids. The Internet plays host to some sites that are on a par with the best that software manufacturers have to offer. One such is Disney Interactive's **Blast**, a subscription site geared toward children 12 and younger.

Games, comics, stories, and puzzles featuring popular Disney characters such as Ariel from *The Little Mermaid* and Winnie the Pooh are highlighted on the site's home page. Kids can play a game of Lunar Landing or Chipmunk Checkers, or check out the stats and bios of their favorite sports stars in the Sports area. The Blast Jr. section is designed for younger kids and features read-along storybooks, an online coloring book, and concentration-style games. The site's content is updated daily on weekdays, with a weekend edition posted each Friday.

Children navigate around the site using the D-Browser, a kid-friendly browser that resembles a pared-down version of Internet Explorer. If



they are interested in more than just games, they can send a D-Mail animated e-mail to a friend, post a picture that they've drawn in the online gallery, or download some Disney wallpaper.

Blast is a secure site in the sense that kids can't wander off to uncharted Internet sites from its home page. Parents can also choose to screen or limit a child's D-Mail. A fee of \$5.95 per month or \$39.95 per year (in addition to your regular ISP fees) gets you unlimited access to Blast. You'll need a Pentium PC running Windows 95 with at least 16MB of RAM and a 28.8-Kbps modem to log on (Disney Interactive, 800-634-1986, www.disneyblast.com).—Jennifer Triverio



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What's It All About, Monty?

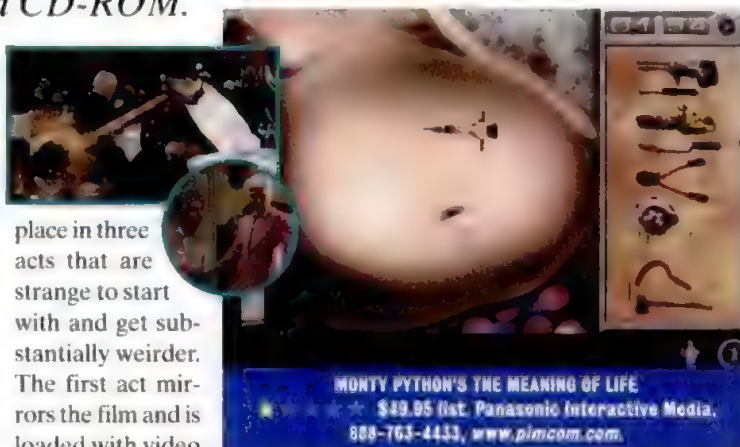
The Monty Python troupe strikes out with its disappointing third CD-ROM.

Monty Python's The Meaning of Life

Just remember that you're standing on a planet that's evolving / And revolving at nine hundred miles an hour...."

If the opening lines of "The Galaxy Song" from the movie *Monty Python's The Meaning of Life* make you want to sing along, then you're the kind of Python fan this game is after. This is the Python troupe's third CD-ROM, following the success of *Monty Python's Complete Waste of Time* and *Monty Python and the Quest for the Holy Grail*. Unfortunately, it's a giant letdown after those two bestsellers.

The *Meaning of Life* takes



place in three acts that are strange to start with and get substantially weirder. The first act mirrors the film and is loaded with video clips. Beginning at the *Wheel of Life*, you choose paths taken from the sections of the film, such as *Birth*, *Growth and Learning*, and *Fighting Each Other*. The goal is to collect ingredients from each area to make a salmon mousse.

Entering Act I is like watching the movie, except that you have to click on the characters to get them to say their lines. The program includes some

from the film. Here you search for the meaning of life along three paths: the material, spiritual, and dental. The animation is attractive, but unfortunately,

the game play is lazy and exasperating. With no clear goal, you are left hunting for objects, then guessing how to use them.

Make it to Act III and things get really strange. The setting is inside a cottage, and you must seek more elusive clues. You'll need hours of serious, dedicated game play just to figure out what you're supposed to do.

Finish all the acts and, yes, you will be told the meaning of life. You'll also get to see a scene that was cut from the original film. That should keep die-hard Python fans plugging away at this frustrating game. —Troy Dreier

new material, but not nearly enough. One new section, a game show parody called "You Don't Know John," lets you answer questions as only a Pythoner would.

Act II makes a sharp break

Space Odyssey

Get the lowdown on outer-space happenings on television's hit series "Babylon 5."

The Official Guide to J. Michael Straczynski's Babylon 5

One doesn't often need a crib sheet to follow the action of a popular television show, but "Babylon 5" is one of those rare exceptions. Like a good novel, the saga of the *Babylon 5* space station is filled with complex characters and political intrigue—which is why *The Official Guide to J. Michael Straczynski's Babylon 5* is such a handy reference for both casual and dedicated viewers of the show.

Designed by the series' production company, the two-disk



CD-ROM guide can be considered the definitive resource for "Babylon 5." Despite the frenetically morphing icons of the interface, this is not a flashy

multimedia package. Rather, think of *The Official Guide* as a next-generation tourism handbook that will help you find your way around the space station and better understand the 15 resident races.

Divided into five sec-

as possible when describing the series' fifth-season story line without skimping on information about people and events from the past, the CD-ROM can get a little confusing. In some places it's up to date, but in other areas, such as the staff directory, it's not.

The most useful and intriguing sections are the ones covering the different governments and ships you'll encounter. The former provides copious detail about the political situations of the alien and human governments, and the latter tells you everything you need to know about the various spacecrafts that come to call.

If you're looking for games or multimedia bells and whistles, you'll be disappointed with *The Official Guide*. But die-hard "Babylon 5" fans will enjoy its depth. —Melissa J. Perenson

tions (station directory, ships, weapons, governments, and places to go). *The Official Guide* offers detailed text introductions supplemented by still images and video clips.

The *Official Guide* runs into trouble when trying to balance the needs of new viewers with those of fans already familiar with "Babylon 5." In its effort to be as current

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After Hours

Bye-Bye, Stick Figures

Finally, there's a drawing tutorial to bring out the artist in all of us.

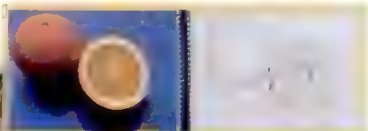
Artist!

Most of us like to doodle: Little shapes, faces, and figures fill up many a margin in our notepads and daily planners. But if you've ever aspired to take your drawing a step farther, consider Ubi Soft's Artist!, a CD-ROM tutorial that starts with the basics and builds impressively.

Did you know that all images can be broken down into simple geometrical forms such as boxes, spheres, and cylinders—and that these shapes can form a skeleton on which to hang your drawing? The secret is to begin by drawing a three-dimensional box, which can be hard enough. The box is then dissected into the four tangents of the

mass, line, plane, value, and the search for realism. Other sections include a sketching memorization course, a hand-and-tool section, and a perspective drill.

To facilitate learning, each drawing is broken down into 20 to 30 small steps, with audio explanations available. The lesson ends with a series of comparative drawings—yours compared with those of masters like van Gogh and Warhol—so you can see how other artists interpreted the same model. The program offers two excellent learning tools that take advantage of the media's technology: a rotating 3-D model of the image and video sequences



that demonstrate helpful drawing techniques. At Ubi Soft's Web site (www.ubisoft.com), you can post the drawings you make, chat with other aspiring artists, and read about current events in the art world.

ellipse and becomes the grid on which you map your drawing. This is the premise on which Artist! bases its lessons.

The disk features tutorials on portraits, landscapes, nude studies, still lifes, and life drawing, which focuses on the general structure of objects. Each category has lessons on

Although the program's interface is not incredibly intuitive, Artist! pays off when you get the hang of moving around in it. As you learn to use the "grid" drawing approach, you'll be amazed at how good your drawings look once you erase the guidelines and add some shading.—*Mary E. Behr*

Coming Up

What's in the Next Issue of PC Magazine

Preview of Windows 98

What's in store for you with the next big operating-system upgrade from Microsoft? Take an early look at the new Windows interface, with a close-up on Active Desktop. Also see our previews of new hardware support and system diagnostics, new multimedia capabilities, and laptop-related enhancements.

Managed PCs

Total cost of ownership is important. We test the current crop of managed PCs: 333-MHz or faster Pentium-based systems designed for networked environments.

Open GL Graphics Accelerators

For serious 3-D graphics work—CAD/CAM, 3-D animation, 3-D modeling, VRML development—you need an accelerator with the power of Open GL. We test eight boards that turn your Intel system into a 3-D graphics workstation for thousands less than a comparable Sun or Silicon Graphics machine.

Project Management

With more workgroups organized around projects, interest in project management software is on the rise. The latest packages combine power with greater ease of use to reach a wider audience. Most include Internet-related features to permit hyperlinks to projects and connect far-flung colleagues.



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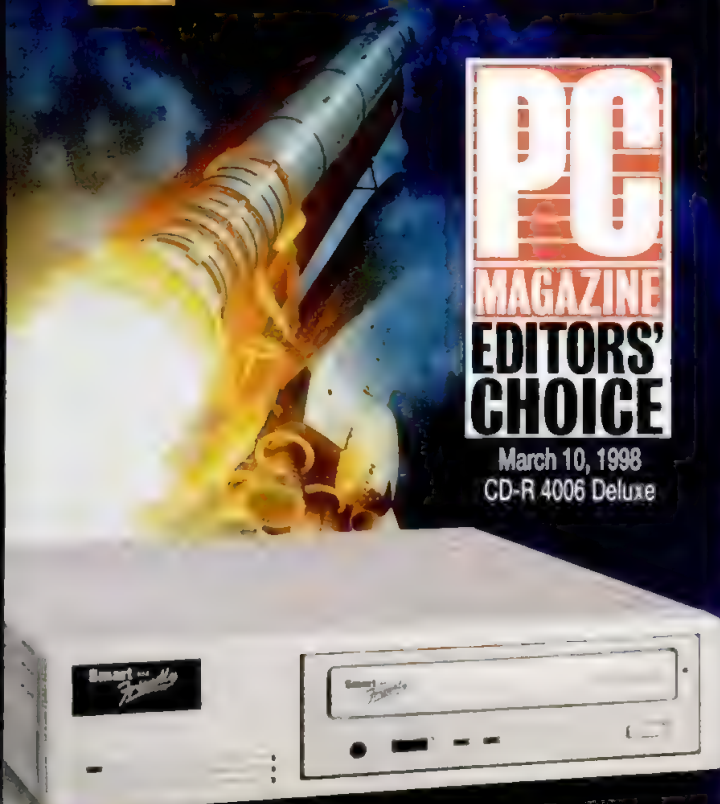
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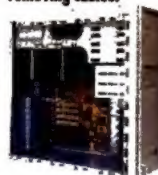
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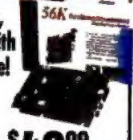
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Abort, Retry, Fail?

Microsoft Technology & Business Conference and Explosion
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Note that this  student driver is going 44 mph in a posted 20-mph zone. (Driver's Education '98 ad.)



No, we don't  understand why *Modern Ferret* magazine devoted its cover to Intel's dancing bunny people.



Funny Furniture Flub

From the assembly instructions for the O'Sullivan Industries computer credenza: "Tray 2B is stamped UP on the up side. When assembling the flip tray, be sure the UP side is down."

What do  virtual flowers smell like? (Connect Time ad.)

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 Was anyone hurt? (Software Consortium brochure.)



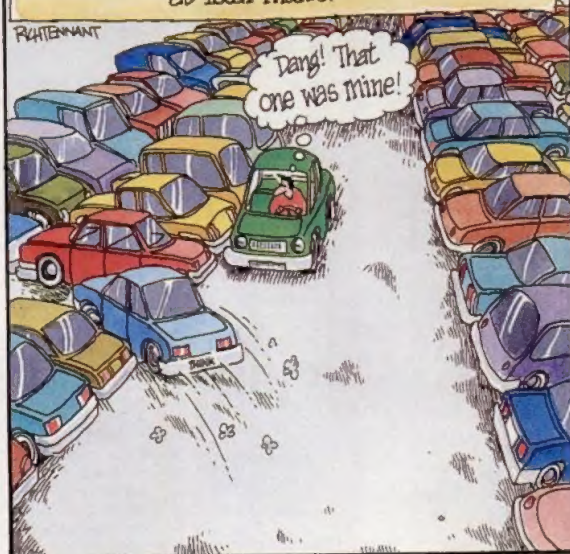
 How not to build customer loyalty. (ChipSmart ad.)

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—BAY COOLER BOX

Shamelessly, IBM, uses Deep Blue to plot, calculate, and then beat Gary Kasparov out of parking spaces at local malls.



If your entry is used, we'll send you \$50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802. Winners this issue: Jeff Anderson, David Filiberti, Craig Hanlon, Andrew Jones, Jose Muller, and Bryan Osborne.

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